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ANATOMICAL LECTURES

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Samuel Tardrew
Caermarthen

OR,

THE ANATOMY OF THE
HUMAN BONES, NERVES,
AND
LACTEAL SAC AND DUCT.

CONTAINING

Not only the mere deſcriptive or proper Anatomical Part of OSTEOLOGY, but alſo Obſervations on the Structure and morbid Phænomena of BONES.

By a SOCIETY of GENTLEMEN.

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A COURSE OF

ANATOMICAL LECTURES.

LECTURE I.

ANTHROPOGENESIS.

THE ſolids, which conſtitute the moſt ſimple and real baſis of the animal body, have this fabrick in common with vegetables; that their elements, or the ſmalleſt parts that can be diſcovered by the beſt microſcope, are either fibres, or an unorganized concrete.

A fibre in general may be mathematically conſidered as reſembling a line formed of points, having a moderate breadth; or rather geometrically, as a ſlender cylinder; and that the more permanent parts thereof conſiſt of earth, is evident from calcination or long continued putrefaction.

The connexion and power of coheſion of theſe earthy particles depend on the intermediate glue placed betwixt them, as appears from this eaſy experiment, a burnt hair, the parts whereof yet hang together, recovers a degree of firmneſs by being dipped in water or oil: and from this circumſtance, that ivory, hartſhorn, or bones, the jelly of which has been extracted by calcination, or long expoſure to the air, become porous and brittle.

This glue is compoſed of oil combined with water, air, and a ſmall portion of iron or its ore, as appears on a chymical analyſis. The air ſeems to conduce highly to its power of adheſion, as it is now well known that the elements of bodies whether animal, vegetable, or mineral, ceaſe not to cohere together until their fixed air has been extracted.

Thus earthy particles cohering longitudinally, and connected together by an intervening coheſive glue, compoſe firſt one of the leaſt or moſt ſimple fibres, ſuch as we have a knowledge of rather from reaſon than ſenſe, as the beſt microſcopes are inſufficient to lead us to a ſight of the ſmalleſt moving and nervous fibrils, nature never ſubjecting herſelf to our ſenſes in her moſt ſimple ſtate; as is obvious from the innumerable animalcules, which, though ſo minute as to be ſcarcely diſcernible by the aid of the beſt magnifying lens,

are

are compoſed of ſtill ſmaller particles, as we are ſenſible from their being endued with life, and a power of motion. Beſides, the muſcular fibres, examined by a microſcope, though divided into the minuteſt threads poſſible, appear ſimilar to the larger, till they ſeem mere lines like ſpider's threads, and at laſt become quite inviſible.

The ſecond kind of fibres are ſuch as connect in breadth, and, in conjunction with the former, compoſe what is called the cellular ſubſtance, which is made up of theſe fibres and little ſcales joined in various directions, intercepts ſmall cells, and web-like ſpaces, and extending round every even the leaſt moving ſolid parts of the body, connects them together in ſuch a manner as not only to ſuſtain, but at the ſame time to allow them a full and free motion.

This cellular ſubſtance is found throughout every part of the human body without exception, viz. wherever any veſſel, or moving muſcular fibre can be traced. But in different parts of the body this membrane differs extremely in reſpect to the proportion between the membranous ſides and intercepted cellules, as well as the breadth and ſtrength of thoſe ſides, and the nature of the fluid contained therein, which is ſometimes more aqueous, and at other times more oily.

This ſubſtance in its ultimate or fineſt ſtate, when compacted and convoluted, gives origin to the moſt minute or moſt ſimple veſſels, which again reflected through plates of the ſame ſubſtance compacted together, form compound and vaſcular membranes.

Out of this web-like cellular ſubſtance compacted by a concretion of the membranous plates or partitions, and preſſed together by the force of the incumbent muſcles and diſtending fluids, are formed other broad and flat plates in various parts of the body, which being generally diſpoſed in the ſame direction, are called membranes, with greater propriety than the former; and being convoluted into cones and cylinders, and pervaded by a flux of ſome fluid brought to them, aſſume the name of *veſſels*; or being extended round ſome ſpace in a plane paralled to itſelf, is called a *tunic* or coat. That theſe are formed out of the cellular ſubſtance may be ſeen, particularly in the aorta, and dura-mater, by maceration; and the coats of the muſcles are evidently of a cellular fabric, as they reſemble the texture of other membranes; from a degeneration of the pericardium as a true membrane into the cellular ſubſtance, or membranes of the great blood veſſels of the heart; from the origin of the indurated thick membranes that incloſe encyſted tumours which are formed in this ſubſtance only; from the eaſy change of the coat of the teſticle, named *dartos*, and the nervous coat of the inteſtines into the cellular fabric by inflation.

The veſſels with which the coats are commonly painted, in nowiſe conſtitute the nature of a membrane, but are ſuper-added to the membrane itſelf, which is firſt formed of the cellular ſubſtance. Between the meſhes or ſpaces of the inteſtinal net-work of veſſels perfectly well filled by injection, the remaining white cellular ſubſtance is obſerved to exceed by much the bulk of the veſſels, though from their preternatural diſtention, they fill more of the ſpace than in the living ſubject. As to membranes compoſed of fibres interwoven, or decuſſating each other, none ſuch exiſt, unleſs ligamentous or tendinous fibres are taken for them; which, however, are only ſpread over the face of ſome true membrane.

The other elementary ſubſtance of the human body is a mere glue, evaſated and concreted not within the fibres, but in ſpaces between them, as is manifeſt in the bones of the fœtus, where the fibres may be ſeen very diſtinctly, in the intervals between which the veſſels appear to run; nay, even the filamentary fibres are firſt formed of ſuch a transfuſed glue: and that the membranous, or ſcaly fibres of the cellular ſubſtance, have the ſame origin, appears from thoſe cellular fibres produced in the thorax from a concreted halitus or ſerum transfuſed through the ſurface of inflamed lungs, which thereby adhere to the pleura, theſe perfectly reſembling the true cellular ſubſtance; as alſo from a compariſon of the fœtus with an adult, the ſub-cutaneous cellular ſubſtance having in the fœtus a mere jelly interpoſed in its ſtead between the ſkin and muſcles, which laſt are of a very firm conſiſtence in the fœtus. This is further illuſtrated by the fibrous cake we extract from blood freſh drawn by ſtirring it round with a probe for ſome length of time while warm; and from the membrane, which may be formed thence in the ſame manner, agreeable to the experiment of Ruyſch, and Albinus's membrane from mucus; from the formation of a polypus, ſilk, and glue: and we are convinced the bony fibres are formed firſt of a compacted glue, becauſe, in ſome diſeaſes, the hardeſt bones become ſoft as cartilages, and from the experiments made on bones, with Papin's Digeſtor.

The anthropogeneſis, or formation of the human ſolids, therefore, ſeems begun when a gelatinous fluid, like the white of an egg, with a ſmall portion of fine cretaceous earth, runs together into a thread from ſome kind of preſſure, the cauſes of which we ſhall not attempt to explain. Such a filament, by the mutual attraction of coheſion, intercepting ſpaces betwixt itſelf and others, helps to form a part of the cellular net-like ſubſtance, after having acquired conſiſtency from the adjacent terrene particles, which remain after the redundant aqueous glue has been expelled. And in this cellular ſubſtance, whenever a greater preſſure is laid on its ſcales or ſides, they become fibres, and membranes, and concreting with an unorganized glue, they, laſtly, are converted into bones.

Hence all parts of the body, from the ſofteſt to the hardeſt, differ no otherwiſe than as the latter have more of the earthy particles more cloſely compacted together, with a leſs proportion of the aqueous glue; while the ſofter parts contain leſs earth, and a greater quantity of glue, according to their reſpective degree of ſoftneſs.

Thus an animal, or the human body, is formed of clay, or ſlimy earth, ſince all the ſolids, and even the globular fluids, which circulate, are originally compounded of chalky particles, like thoſe of tobacco-pipe clay cemented together by a glue or jelly; for if a lump of blood, or a bone is calcined or burnt in a clear fire, after the air, water, oil, &c. of which the glue is compoſed, are expelled and conſumed, there remains a white, friable, chalky earth, reſembling the neareſt virgin or elementary earth, of any we are acquainted with.

Nature is then to be equally admired for her wiſe oeconomy, as well as ſimplicity, in thus forming all that variety we obſerve in the animal fabrick, from one ſimple maſs of clay, or ſlimy matter, compounded of earth and glue, from whence the body is not only increaſed from a ſingle point in the ovum to its full growth, but repaired every moment during life, till at length, perhaps, ſcarcely the leaſt jot of the original materials remain.

This renovation of parts is made more ſlowly in ſome conſtitutions, and in ſome organs, than in others. For inſtance, how quickly are the hair, nails, animal humours, &c. renewed; and ſome modern authors have not heſitated to affirm, that once in three years the change is univerſal: ſo that though a man remains the ſame identical perſon, he has not the ſame materials. But ſurely old age is a ſtrong argument againſt this aſſertion.

By a membrane is underſtood a pliable texture of fibres, diſpoſed or interwoven together in the ſame plate: they differ in thickneſs according to the ſmallneſs of the filaments and number of their plates.

Theſe plates are diſtinguiſhed into external, internal, and middle.

The difference of membranes in general depends on that of the fibres, of which they are compoſed; ſmall portions of membranes, eſpecially when they are very thin, are called pellicles, and ſome membranous laminæ are united together by the intervention of a particular ſubſtance compoſed of this ſort of pellicles, and called the cellular or ſpongy ſubſtance.

Veſſels are tubes, ducts, or canals, more or leſs flexible, compoſed of different membranes, the ſtrata of which are generally termed tunics or coats; ſome of them are divided into branches, and theſe again into ramifications, which gradually diminiſh, but ſtill remain concave.

The general deſign of the veſſels is to contain fluids, from the diverſity of which they are diſtinguiſhed into ſanguiferous, lacteal, and lymphatic; the extremities of thoſe which are too ſmall to admit the red globules of the blood, are termed capillaries or lymphatics.

The ſanguiferous veſſels are of two kinds, the one named arteries, receive the blood from the heart, and diſtribute it to all parts of the body; the other ſpecies which return the blood from all the parts of the heart, are called veins, and ſome of theſe are called ſinuſſes.

The arteries have thicker coats than the veins, by which they may be diſtinguiſhed in dead bodies, and in living ſubjects by a certain beating motion, called the pulſe. The veins of the extremities are furniſhed with valves, that is, with ſmall membranous ſemicircular bags, fixed at different diſtances in their internal cavities: the opening of theſe valves is broad, and turned towards that ſide where the vein is largeſt; but their bottoms are turned to the contrary ſide, where the veins are of the ſmalleſt diameter; in ſome places the valves are ſingle, in others double, treble, &c.

Nerves are ſmall bundles of white cylindrical fibres, which proceed from the brain, cerebellum, the medulla oblongata, and ſpinal marrow, and are diſtributed to all the parts of the body by filamentary ramifications. For the purpoſe of ſenſation each nervous filament may be looked on as a membranous veſſel, the cavity of which is filled by a great number of membranous longitudinal partitions and medullary filaments, which lie betwixt them.

Muſcles are collections of fibres, called by anatomiſts moving fibres; they are of a reddiſh colour, and of different lengths.

The middle portion of the muſcular fibres is the principal, and differs from the extremities, it being red, thick, ſoft, and capable of contraction, whereas the extremities are white, ſmall, compact, and incapable of yielding.

The middle portions of each muſcular fibre form what is properly called fleſh, the extremities are called tendons.

Glands are cluſters or ſmall bodies, diſtinguiſhed from all the other parts of the body by their form, conſiſtence, texture and connection; in general are compoſed of arteries, veins, nerves, and excretory ducts, united together in their different convolutions and intertextures, all inveſted with a membrane.

Their office is to ſeparate from the blood, by means of certain ſecretory veſſels, fluids which they diſcharge either immediately, or by other veſſels, termed excretory; and thoſe fluids are either accumulated in particular reſervoirs, or expelled out of the body.

Fat is of an oleaginous, whitiſh, or yellowiſh ſubſtance, of different conſiſtences, collected in cellulous membranes.

Marrow differs from fat only in the fineneſs of the oleaginous ſubſtance, and in its ſituation within the bones. The word marrow is ſynonimous with fat.

Viſcera. By this expreſſion we mean parts contained in a large cavity, without being connected to it through their whole extent or circumference; ſuch as the ſtomach, liver, inteſtines, &c. in the abdomen; and the heart and lungs in the thorax, &c.

Organs. This name is given to every part capable of any function, whether ſimple or complex; and in this ſenſe we ſay the organ of ſight, of reſpiration, &c.

A ligament is a white fibrous compact ſubſtance, yet flexible and elaſtic.

A cartilage is a hard elaſtic ſubſtance.

Bones are the moſt compact fibres of the body, therefore the hardeſt ſubſtance which forms the baſis of the whole animal fabric, the knowledge thereof is the fundamental part of the animal oeconomy, and without which it is impoſſible to have a perfect idea of the mechaniſm of the human frame; we ſhall therefore begin with them, and make Oſteogeny the ſubject of our next lecture.

The fluids contained in ſolids are the blood, ſerum, and lymph, and from theſe all the other liquors are ſecreted.

Every part of the animal exiſts in miniature from the firſt moment the uterus is impregnated, and afterwards gradually increaſes by the extenſion of its parts.

LECTURE II.

OSTEOGENY.

BONES, the moſt hard and ſolid parts of the body, in a living animal, are of a bluiſh colour, owing to the blood in the ſmall veſſels beneath their ſurface. The leſs and fewer the blood veſſels, and the firmer the bony ſurface, the whiter are the bones: hence the bones of adults are whiter than thoſe of children; and in both, the whiteneſs of the different bones, or of the ſeveral parts of the ſame bone, is always in proportion to their veſſels; circumſtances that merit the attention of ſurgeons when they are to form a judgment of the condition of bones laid bare.

Bones are compoſed of a great many plates, each of which conſiſts of fibres united by ſmaller fibrils, which being irregularly diſpoſed and interwoven with the other larger fibres, form a kind of net-work. This texture is apparent in the bones of fœtuſſes, and in thoſe of adults which have been calcined, or long expoſed to the weather. The chinks, which are generally made according to the direction of the larger fibres, in bones that have been calcined, or long expoſed to the air, ſhew that theſe are ſtronger than the connecting fibres.

The plates, according to Gagliardi, are firmly joined together by claviculi, or ſmall bony proceſſes, which, taking their riſe from the inner plates, pierce through ſome, and are affixed to the exterior ones. Malpighi has deſcribed four kinds of theſe, viz. the perpendicular, oblique, headed, and crooked.

Though the external ſurface of bones is compoſed of firm compact plates, yet the internal part is in all more or leſs cavernous. This internal ſpongeous ſtructure is manifeſt in young animals; and may be ſeen, in ſome meaſure, even in the bones of old people, if cautiouſly opened after calcination, or a long expoſure to the weather.

This ſpongeous internal part is called their cancelli, or lattice-work, and is thus formed. The plates are firmly joined about the middle of the bone; but as they are extended towards its ends, the more interior ſeparate from the exterior plates, and ſtretch out their fibres towards the axis of the bone, where they are interwoven with the fibres of other plates that have been detached in the ſame manner. The plates being thus conſtantly going off, the ſolid ſides of the bone become gradually thinner, and the lattice-work thicker and ſtronger towards its extremities.

The convolutions which theſe cancelli make, and the interſtices they leave, differ conſiderably in figure, number, and ſize; and therefore form little cells, which are as different, but have a communication with each other. Their uſe is to ſuſtain the membranous bags of the marrow which are ſtretched on them, and thereby hinder their being torn or diſplaced from the violent motions and different poſtures of the bones, and to prevent its membranes and veſſels in the lower parts of the bones from being compreſſed by the weight of the marrow above.

The depreſſions between the fibres of the external plates of bones on their ſurface, reſemble ſo many furrows, into each of which the perioſteum or membrane that covers the bones enters, whereby the ſurface of contact, and of courſe the coheſion between that membrane and the bone is conſiderably increaſed, and a greater number of veſſels paſs through it into the bone, than poſſibly could if it was a plain ſurface.

Numerous orifices of canals are to be obſerved both on the ridges and furrows, through which the veſſels paſs into, and from the bones; and after a ſucceſsful injection, the arteries may be traced in their courſe to the very plates and fibres; and are diſcovered in living animals, by the ſmall drops of blood which ooze from the moſt ſolid part of the bones when cut, ſawed, or raſped; and from the effect of madder-root, which, when ſwallowed, digeſted, and mixed with the blood of any living creature, tinges the bones of a red colour, which diſappears again when the beaſt returns to his uſual food. The arteries are larger near each end, than in the middle of the large bones that are liable to much motion; becauſe they not only ſerve the bony plates near the ends, but paſs through them to the marrow. They become leſs capacious as animals advance in age, as is apparent from the bones of old creatures being more difficultly tinged with madder than thoſe of young ones.

As arteries are accompanied with veins in every other part of the body, ſo far as we can trace; and as the diſappearance of the red colour, when bones of living animals have been tinged with madder, could not be effected, without it was carried off by veins, we may conclude that the bones have veins; nay, Le Suel aſſerts, that injections will ſometimes paſs into the veins of bones, which are then viſible.

The bones in their natural ſtate are inſenſible, and the nerves diſtributed throughout their ſubſtance, cannot be demonſtrated by diſſection; but it is evident they have nerves, from their exquiſite ſenſibility when diſeaſed.

It is evident, therefore, from the ſtructure of bones, that a conſtant circulation of fluids is maintained in every part of them; and that there is a perpetual abraſion and renewal of the particles that compoſe the ſolid fibres of bones as well as of other parts of the body; the addition from the fluids exceeding the abraſion during their growth; and the abraſion exceeding the ſupply from the fluids in old age; as their weight proves: for the bones increaſe in gravity as perſons approach maturity, continue nearly of the ſame weight till old age approaches, and then become lighter. Their ſolidity, on the contrary, increaſes by age; in conſequence whereof the bones of aged perſons are thinner, harder, and more compact in their ſides, and their cavities are larger than thoſe of young bones.

Their vaſcular ſtructure renders bones liable to obſtructions, ecchymoſes, ulcers, gangrenes, and moſt other diſeaſes that affect the ſofter parts.

On the internal ſurface of the ſolid parts of bones, Havers has obſerved orifices and canals that paſs outwards through the plates to open into others placed in a longitudinal direction, from which other tranſverſe canals paſs out to terminate in other longitudinal canals; and this ſtructure takes place throughout their whole ſubſtance, both kinds becoming gradually ſmaller as they approach the outer ſurface.

Theſe canals are beſt ſeen in a calcined bone: when broken tranſverſely, the orifices of the longitudinal canals appear; the tranſverſe ones, when the plates are ſeparated. Theſe canals contain marrow, as is evident from the drops of oil that may be diſcovered with a microſcope every where on the ſurface of a freſh bone fractured tranſverſely, and from the oil that exſudes through the moſt ſolid bones, and renders them greaſy and yellow.

In general each bone has one or more large oblique canals that perforate its ſides, to allow a paſſage for the medullary veſſels.

The bones are lined within, as well as covered externally with a membrane called the perioſteum. The internal perioſteum is extremely thin; and being of a looſe reticular texture, is compared by ſome anatomiſts, to the arachnoid coat of the ſpinal marrow, therefore cannot be divided into two lamina, like the external perioſteum. Its proceſſes may, however, be obſerved entering into the tranſverſe pores of the bones; and theſe proceſſes being of a very delicate texture, this membrane adheres ſo ſlightly to the bone, that it ſeparates commonly more readily from it, than from the marrow it contains.

A great number of thin membranes are formed from the internal ſurface of the internal perioſteum, which paſſing through the cavity in a tranſverſe direction, unite with other ſimilar ones, and form diſtinct bags, which have a communication with each other, and are again ſubdivided into communicating veſicles which contain the marrow: whence the marrow examined by a microſcope in a coagulated ſtate, reſembles a cluſter of ſmall pearls; and the marrow of bones long buried, or dried after having been ſteeped in water a long time, is granulated. The ſame texture is obſerved in other cellular parts of the body where fat is collected.

The marrow is the oleaginous part of the blood ſeparated by ſmall arteries, and depoſited in theſe cells; whence its colour and conſiſtence varies according to the ſtate of the veſſels, and their diſtribution on the membranes of the cells.

Beſides the arteries already mentioned, each bone has at leaſt one artery, ſome more, whoſe principal uſe is to ſecern and convey this oil. Theſe veſſels, when they have pierced the ſolid ſide of a bone, are divided into ſeveral branches, which are diſtributed all over the internal perioſteum, and are afterwards ramified inwardly on the medullary cells, and, outwardly, through the bony lamina. The remaining blood, after the marrow has been ſecreted, is returned by proper veins, which at length forming one or more large trunks, paſs out through the ſame hole at which the arteries entered. The trunks of the medullary veſſels grow larger as animals increaſe in years: the ramifications, however, become ſmaller, as injections prove, which do not paſs near ſo far in the medullary veſſels of adults as in thoſe of children, whence the marrow is bloody in children, oleaginous and balſamic in adults, and thin and aqueous in thoſe far advanced in years. Thus the general rule, that the ſmall veſſels decreaſe in their capacities as animals grow older, takes place here alſo.

Experiments, and the excruciating pain with which internal ſuppurations in bones are frequently attended, prove the ſenſibility of the membranes, and of courſe that nerves are diſtributed to them. The medullary veſſels inveſted in one common coat from the perioſteum, pierce through the bones by oblique canals, the principal of which are ſituated towards the middle of the bone.

The medullary oil being, as appears from the ſtructure of bones, communicated to all the plates, ſoftens and connects their fibres, and thereby preſerves them from becoming brittle. The articulations of the bones are ſuppoſed to receive equal advantage from it, it being imagined that the medullary oil paſſes into the cavities of the joints through the foramina, which are found in bones near the large joints.

When the medullary oil, having anſwered theſe purpoſes, is abſorbed again into the maſs of blood, it corrects the ſaline particles of the fluids, rendered too acrimoninous from their circulation and heat. Hence in acute diſeaſes the medullary oil, as well as the fat in other parts of the body, is quickly waſted, but muſt be immediately ſupplied by liquids from the veſſels ; and as the cells within the bones cannot collapſe, not being aided by the preſſure of the atmoſphere, the bones, for this reaſon, are always full.

It being the nature of oil to become thin and rancid when long expoſed to heat, the diſagreeable ſmell, and dark coloured thin ichor that is diſcharged in greater quantity from carious bones, than from other parts, and the different changes of colour which diſeaſed bones undergo, are with reaſon aſcribed to this cauſe ; from which likewiſe proceeds the ſpina ventoſa, the quick pulſe, thirſt, and hectic paroxyſms, that frequently attend theſe diſeaſes, and the difficulty of curing all caries of bones cauſed by a putrefaction of the marrow. Hence alſo we learn, why black fœtid urine is ſo fatal a ſign in fevers.

Notwithſtanding this agreement in the ſtructure of bones, they conſiderably differ in their ſize, figure, ſituation, ſubſtance, connection, and uſes ; whence they have been divided by authors into as many different claſſes: which being obvious to every one at firſt ſight, we ſhall mention only one of theſe diviſions, which comprehends almoſt all the bones of the human body, viz. that ſome are broad and flat, and others long and round.

The ſides of the broad bones are thin, the plates being ſoon and equally ſent off to form the lattice work, which on that account is thick, and nearly of the ſame form throughout the whole bone. This ſtructure is well adapted to their uſes of affording a ſufficient ſurface for the attachment of the muſcles and their motion, and of defending properly the parts incloſed thereby.

The round bones in the middle have thick compact walls, which gradually become very thin towards their extremities, owing to very few plates ſeparating about their middle, where the cancelli are ſo fine, that they almoſt eſcape notice, but ſuch bones are ſuppoſed to contain a large quantity of oil in this part. Towards their extremities the lattice work becomes very thick, and, indeed, more compleat than in bones of the other kind; having ſtrong forces naturally applied to them, and being in other reſpects expoſed to violent injuries, this cylindrical form, and the thickneſs of their ſides, is neceſſary for the better reſiſtance of external preſſure; and the oil therein found in large quantity, prevents their becoming too brittle.

The ſtrength of bones depending on their number of fibres, and the ſize of their diameters, the part of a bone re-united by a callus muſt be ſtronger than it was before it was fractured, as both advantages are obtained by means of the callus, which for want of due compreſſion, ſometimes forms itſelf into a ſpongy cellular ſubſtance.

Many bones have protuberances or proceſſes on their ſurface. A proceſs projecting in the form of a roundiſh ball, is called an head; which, if flatted, is termed a condyle; if rough and unequal, a tuberoſity; if it riſes narrow, and then becomes larger, the ſmall part is named a neck; long bony ridges are called ſpines; thoſe which end in a ſharp point have the general name of coronoid: though moſt ſuch proceſſes receive particular names from their fancied reſemblance to other ſubſtances, as maſtoid, ſtyloid, coracoid, ſpinal, &c. Such as form the edges of cavities receive the appellation of ſuperciliary.

Their uſe is to ſerve for the advantageous attachment of the muſcles, and to render the articulations firm and ſtable.

Moſt of the proceſſes obſerved in adult bones, were, in children, epiphyſes, or diſtinct bones, that are afterwards united to the other parts of the oſſification, gradually proceeding from the end of the bone, and from the epiphyſes, till, at length in adults, the place of their conjunction is no longer viſible.

The cavities, or depreſſions on the ſurfaces of bones, if deep, with large brims, are called cotyloid; if ſuperficial, glenoid. Theſe are again ſubdivided into pits, or ſmall round channels ſunk perpendicularly into the bone; furrows, long narrow canals in the ſurface; nitches, ſmall breaches in the bones; ſinuoſities, broad ſuperficial depreſſions without brims; foſſa, large deep cavities unequally ſurrounded with high brims; ſinuſſes, large cavities within the ſubſtance of the bones, with ſmall openings; foramina, holes that penetrate through the ſubſtance of the bones; and, if extended any length within a bone, the middle part is called a canal.

Their uſe is to allow the heads of the bones to play in them, to lodge and defend other parts, and to allow a ſafe paſſage to veſſels, muſcles, &c.

The epiphyſes are principally united to the bones intended to undergo frequent and violent motion, on which account they are of a larger diameter then the bone itſelf; whereby the ſurface of contact being increaſed between the two bones of an articulation, the conjunction becomes firmer, and the muſcles attached thereto, act more forcibly, their axes being removed to a greater diſtance from the center of motion. They alſo ſecure the ligaments of the articulations, which riſe out from between the bones and them; for as ſoon as theſe parts are intimately joined, the ligaments, inſinuated betwixt them, muſt have a far ſtronger connection than they could have to the ſmooth ſurface of the bones. The celebrated Haller thinks, the ſoftneſs of the extremities of bones may be of ſome advantage in the womb, and at birth; after which the oſſification begins, at different points, to form the epiphyſes, before it can extend from the middle of the bone to its extremities.

Diſſections of embrios evince, that adult bones, however ſolid and compact, were once cartilaginous, membranous, and even a mere jelly; which, by degrees, acquiring more ſolidity, at length became changed into bone.

When any part of a bone is thoroughly oſſified, its fibres are extended little more in length at that part, though they are increaſed in thickneſs, and though the ſofter parts continue to become longer, as we learn from the experiments of the ingenious Hales.

The oſſification of bones depends principally on their veſſels being ſo diſpoſed, and of ſuch diameters as to ſeparate a fluid, which is eaſily converted into a bony ſubſtance, when deprived of its thinner parts, as appears from the growth of the callus after fractures. The induration of bones is greatly aſſiſted by their being expoſed to the ſtrong preſſure of the vaſt weight they ſuſtain, to the violent contraction of the muſcles attached to them, and to the impulſe of the parts contained, which ſtrive to make way for their own further growth; whence the ſolid fibres and veſſels of bones are preſſed cloſer, and the particles of the fluids conveyed in theſe veſſels, which are fit to be united to the fibres, are ſooner, and more firmly incorporated with them, while the remaining fluids are forced out by the veins, and mixed with the maſs of blood; wherefore, as the bones harden, the veſſels gradually become ſmaller. This opinion is confirmed from anatomical obſervations; and, from this circumſtance, that oſſification, in bones, begins in the cylindrical ones from a middle ring, and, in the broad ones, from one or more diſtinct points near their centre; theſe parts being contiguous to the bellies of the muſcles attached to them, where the ſwelling of theſe moving powers is greateſt. Beſides, if it be admitted, that every part of a bone is equally enlarged by a conſtant ſupply of freſh particles, each fibre, even the minuteſt, endeavours to make way for its own growth, by puſhing the one next to it, and, conſequently, by much the greateſt preſſure is exerted in the middle to render the particles firm; for which reaſon oſſification begins there. The pulſation of the medullary arteries, may, perhaps, in ſome meaſure, conduce to the ſame intention.

The greater thinneſs, denſity, and ſolidity of the ſides of the bones in aged perſons, while the cavities are far larger than in young ones, can only be accounted for from the effects of preſſure. And this muſt alſo be the cauſe why the impreſſions of the muſcles, veſſels, &c. are ſo ſtrongly marked on the ſurfaces of the bones of old people, as well as why theſe marks are ſtronger in the bones of thoſe who have been uſed to hard labour, than of thoſe who have lived in a ſtate of indolence and inactivity. The above cauſes of oſſification may perhaps alſo be aſſiſted by the nature of the climate and the food.

Bones are covered externally, as well as lined internally by a membrane, on that account called the perioſteum, which, like moſt other membranes, is capable of being ſeparated into different layers of fibres. The exterior ones compoſed of the muſcular fibres attached to the bones, differ in their ſize, number, and direction, whence this membrane is of different thickneſs and ſtrength in different bones, and even in different parts of the ſame bone. The internal layer is every where nearly of a ſimilar ſtructure, and its fibres run in the ſame direction with thoſe of the bone which they cover.

The external ſurface of the perioſteum, except where muſcles, cartilages, or ligaments, are inſerted into it, is connected to the contiguous parts, by thin, cellular, elaſtic membranes, which if divided or broken, collapſe ſo much that the ſurface of the perioſteum appears quite ſmooth.

Injections prove the exiſtence of arteries in the perioſteum; for after a ſucceſsful injection, if this membrane is torn off, the ſurface of the bone appears covered over with red points; and the veins correſponding to theſe arteries may ſometimes be ſeen in ſubjects that die with their veſſels full of blood, though they can ſeldom be demonſtrated in equal number, as few of them naturally allow a paſſage to coloured fluids.

That this membrane is plentifully provided with nerves, though too ſmall to be traced, is evident from its exquiſite ſenſibility in an inflamed or diſeaſed ſtate.

Its principal uſes are: To allow the muſcles, when they contract or are ſtretched, to move and ſlide eaſily upon the bones; the ſmooth ſurface of this membrane preventing any ill effects from their friction on one another; to ſupport the veſſels in their paſſage to the bones: to check their overgrowth; to ſtrengthen their conjunction with their epiphyſes, ligaments, and cartilages; which in young animals are ſeparated with eaſe when this membrane is removed: to afford a convenient attachment to ſeveral muſcles fixed thereto: and to give warning when any injury is offered to the parts it covers, which being inſenſible might otherwiſe be deſtroyed without our knowledge.

The articulations of bones are commonly divided into three claſſes, viz. ſymphyſis, ſynarthroſis, and diarthroſis. Symphyſis is uſed by moſt authors to denote the bones to be connected by ſome other ſubſtance; and is divided into ſynchondroſis when a cartilage is the connecting ſubſtance; ſyneuroſis, or ſyndeſmoſis, when ligaments are uſed for that purpoſe: ſyſſercoſis, when muſcles are ſtretched from one bone to another.

Synarthroſis, the general term uſed to expreſs the immoveable conjunction of bones, is divided into three kinds: the ſuture where two bones are mutually indented into each other, as if ſewed together, from the fibres of two bones meeting, while yet flexible, and mutually forcing into the interſtices of each other, till meeting with a reſiſtance they are unable to overcome, they are ſtopped or reflected; whence theſe indentations vary greatly in their form and ſize: gomphoſis, which ſignifies the fixing of one bone into another, as a nail is fixed into a board: and ſchindyloſis, or ploughing, when a thin plate of one bone is received into a long narrow furrow of another.

Diarthroſis, by which term the celebrated Monro means that ſpecies of articulation whereby the bones are fitted for motion, being each covered with a ſmooth cartilage, connected by one or more common ligaments, and lubricated by a fluid at the parts where they are joined together. The firſt kind of this mode of articulation is called enarthroſis, by which is defined that ſpecies where a round head of one bone is received into the cavity of another, and of courſe is capable of motion to all ſides, unleſs prevented by ſome foreign impediment: arthrodia, or the ſecond kind, only differs from the former in the cavity's being more ſuperficial, and therefore, with Veſalius, ought to be called, that articulation of two bones adapted for motion, where, at firſt ſight, it is not obvious to which of the two the head or cavity belongs, or where they are joined by plain ſurfaces, or nearly ſo.

Ginglimus, or that kind of articulation by the form whereof the motion muſt be almoſt wholly confined to two directions only. Of this, the trochoides, where one bone turns on another in the ſame manner as a wheel on its axis, is the firſt ſpecies: that articulation where ſeveral prominent and hollow ſurfaces of two bones move on each other within the ſame ligament, conſtitutes the ſecond. The third ſpecies of ginglimus is where two bones are conjoined together at different parts with a diſtinct apparatus of the motory machines at each.

We ſhall next conſider the ſtructure, ſituation, and uſes of the cartilages, ligaments, and mucilaginous glands of the joints.

A Cartilage is a whitiſh or pearl-coloured ſubſtance, which covers the extremities of bones joined together by moveable articulations, increaſes the bulk of ſome of them in the ſame manner as epiphyſes, unites others very cloſely together, and has no immediate adheſion of connection with others.

They are ſolid, ſmooth, white, and elaſtic, between the hardneſs of a bone and ligament; and covered with a membrane named perichondrium, which is of the ſame ſtructure and uſe as the perioſteum, but not ſo ſenſible.

Cartilages are formed of layers much of the ſame nature as thoſe of bone; their coheſion differs in various parts, and they have no cancelli, are more tender and leſs friable than bones; are pliable and elaſtic; but with age ſometimes perfectly oſſify.

Whether cartilages are ſubject to exfoliation as well as bones may be doubted; their ſtructure is beſt ſeen by boiling or expoſure to the weather.

Thoſe which are united to the bones are of four kinds.

Some cover both ſides of the moveable articulations, and are very ſmooth and ſlippery.

Some unite the bones to each other, either ſo firmly as to allow of no ſenſible motion, or in ſuch manner as to allow of different motions. The firſt eaſily become hard, the ſecond ſeem in ſome meaſure viſcid, and retain their flexibility.

Some increaſe the ſize and extent of bones: of theſe again, ſome are articulated with other bones, or with other cartilages; others ſerve only for borders.

Some, in fine, have a ſingular form; as thoſe of the ears and of the noſe; in which laſt their elaſticity is moſt ſenſibly perceived.

The cartilages belonging to the ſecond general claſs, or thoſe not immediately joined to the bones, are, for the moſt part, placed in moveable joints, and may likewiſe be ſub-divided into ſeveral kinds.

Some lie altogether looſe, being joined neither to the articulated bones, nor to the cartilages which cover them; but ſlide freely between them in different directions. Some are partly joined to other cartilages, and partly ſlide between the cartilaginous extremities of the articulated bones.

We might likewiſe reckon among the cartilages, though more improperly, ſeveral ſmall ſeſamoide bones, which remain long cartilaginous; and alſo the cartilaginous portions of tendons, which do the ſame office with the ſeſamoide bones.

The cartilages are compoſed of layers, diſpoſed in much the ſame manner as thoſe of the bones, as might be reaſonably concluded from obſerving bones in a cartilaginous ſtate before they oſſify; and that ſo many cartilages become oſſeous. Their ſtructure may be demonſtrated after boiling, burning, or expoſing them to weather.

While cartilages are in a natural ſtate, it is to be remarked, firſt, that they have no cavity in their middle for marrow: ſecondly, that their exterior ſurface is ſofteſt, which renders them more flexible: hence it is that injected liquors eaſily fill the veſſels on their ſurface, but ſeldom penetrate to the middle ſolid part. And laſtly, that as the ſpecific gravity of cartilages is near a third leſs than that of bones, ſo the coheſion of their ſeveral plates is not ſo ſtrong as in bones; whence cartilages laid bare in wounds or ulcers, are more liable to corrupt than bones.

Cartilages ſeem principally kept from oſſifying, either by being ſubject to alternative motions of flexion and extenſion, the effects of which are very different from any kind of ſimple preſſure, or by being conſtantly in a moiſt ſtate. Thus the cartilages on the articulated extremities of the great bones, and the moveables ones placed between the moving bones in ſome articulations, which are obliged to ſuffer many and different flexions, and are plentifully moiſtened, ſcarce ever change into bone, while thoſe of the ribs and larynx are often found oſſified. The middle angular part of the cartilages of the ribs, which is conſtantly in an alternate ſtate of flexion and extenſion, by being moved in reſpiration, is always the laſt that becomes bony. In the larynx, the epiglottis, which is oftener bended, and more moiſtened than the other four cartilages, ſeldom is oſſified, while the others as ſeldom eſcape it in adults.

The cartilages begin to oſſify on their external ſurface, unleſs when moiſture or flexion impede it; and the oſſification proceeds internally till the cancelli are at laſt formed, when a ſort of marrow is depoſited in them. While this change is bringing about in the ſubſtance of the cartilages, their blood veſſels gradually appear bigger towards their internal ſubſtance, and leſs on the external.

The cartilages being naturally of ſuch firm ſubſtance, and of a compoſition a-kin to the bones, will gradually acquire greater ſolidity by conſtant preſſure; and this change will be made ſooneſt and moſt remarkably, where the preſſure is greateſt, that is, at their external ſurface. The exterior plates, when oſſified, are more compact and denſe than before, and therefore they will have a ſtronger power of attracting thoſe in contact with them, while the branches of veſſels diſtributed to the firſt oſſified lamella, and thoſe that run in the interſtices of the fibres of this, and thoſe next to it, being now more compreſſed than formerly, will have a leſs quantity of fluids paſſing through them, and conſequently the other branches will receive a proportionable quantity; the momentum of which, added to the power of attraction, or force of coheſion, increaſed by the greater ſolidity of the plates, will increaſe the preſſure upon the more interior ones, and haſten their hardening; after which, theſe laſt plates will produce the ſame effects on thoſe contiguous to them; and thus the oſſification goes on, till all are become oſſeous. The body thus changed, will have its former dimenſions, or nearly ſo; becauſe its external part oſſified firſt, and being rigid, yields little or nothing to the powers that draw it towards the axis of the bone. But as the new particles received from the circulation of the fluids, during the oſſification, do not overbalance the condenſation which the particles in general undergo, and thereby the plates occupy leſs ſpace than they did in a cartilaginous ſtate, a cavity is left in the middle. And as all the plates cohere, and have croſs fibres joining them, many of theſe fibres are ſtretched irregularly from one ſide of the cavity to the other, and therefore form the cancelli. The branches of the veſſels, formerly diſtributed to the plates, being now much leſſened, the remaining branches which run tranſverſely, are frequently proportionably encreaſed, become very conſpicuous, and are diſperſed every where in the cavity, to ſerve for the ſecretion of the marrow. Thus this flexible elaſtic ſolid ſubſtance becomes a rigid inflexible cavernous bone with marrow contained in its cancelli.

The cartilages ſubſervient to bones are ſometimes found on the extremities of thoſe which are joined to no other, but are never wanting on the ends and in the cavities of bones deſigned for motion: and in more than one inſtance cartilages are interpoſed between ſuch other cartilages as cover the heads and cavities of articulated bones; nay, they are alſo placed between immoveable ones.

The uſes of cartilages, ſo far as they regard the bones, are to allow, by their ſmoothneſs, the bones deſigned for motion to ſlide eaſily without detention; while by their flexibility they accommodate themſelves to the ſeveral forms neceſſary in different motions, and by their elaſticity recover their natural poſition and ſhape, as ſoon as the preſſure is removed. This elaſtic force may alſo aſſiſt to render the motion of the joint more expeditious: to theſe cartilages the ſecurity of the moveable articulations is chiefly owing; for without them the oſſeous fibres would ſprout out, and intimately coaleſce with the adjoining bone; whence a true anchyloſis muſt neceſſarily follow, which never fails to happen when the cartilages are eroded. The moveable cartilages, interpoſed in articulations, cauſe the motions to be both freer and more ſafe than they would otherwiſe be. Thoſe placed on the extremities of bones not articulated, prevent the bony fibres from growing out too far. They ſometimes ſerve as ligaments, either to faſten together bones immoveably joined, or to connect bones that enjoy manifeſt motion. Cartilages alſo very often do the office of bones to greater advantage.

A Ligament is a white fibrous cloſe compact ſubſtance, more flexible than a cartilage; not eaſily ruptured or torn, and which does not yield, or at leaſt but very little, when pulled.

It is made up of very ſmall and very ſtrong fibres, which by their different texture and diſpoſition, form narrow cords, or broad or thin membranes; and theſe ſerve to bind, contain, limit, and defend the other parts both hard and ſoft.

I am not here to ſpeak of the ligaments peculiar to the ſoft parts; but confine myſelf wholly to thoſe which belong to the bones or cartilages alone. Of theſe we may eſtabliſh two general claſſes, the firſt, containing thoſe ligaments which are of uſe only to the bones in which they are inſerted; the other, containing thoſe which ſerve for other parts beſides the bones in which they are fixed, and principally for the muſcles. If we have regard to bones only, theſe laſt are improperly termed ligaments, as not doing the office of ſuch, and conſequently reſembling the true ligaments only in texture.

Of theſe ligaments, which are fixed in the bones or cartilages alone, and are not employed about the other parts, ſome belong only to the articulations or moveable bones, and others have nothing to do with the articulations.

The ligaments which belong particularly to the moveable articulations may therefore be called articular ligaments, and are of ſeveral kinds.

Some are deſigned only to fix and ſtrengthen the articulations, and ſecure the bones in their different motions from parting from each other, as it happens in luxations. Theſe ligaments are like ropes, more or leſs flat; or like membranes, ſometimes narrow and ſometimes of a conſiderable breadth; and though all of them are thin, they are all very ſtrong, and yield but little. The ligaments of the articulations by ginglimus, and thoſe that tie the bodies of the vertebres together, are of this kind.

Some contain a very fluid and mucilaginous liquor called ſynovia, which continually moiſtens the articulations. Theſe are not ſo properly ligaments, as ligamentary membranes, bound immediately round the articulations, and fixed to the extremities of the articulated bones, and thus forming capſules, or bags, to contain that liquor, and hinder it from running out.

Theſe may very well be named capſular ligaments. They lie within the former ſort, being cloſely united to their internal ſurface, and are to be met with in all the moveable articulations, as in that of the ulna with the humerus, thoſe of the bones of the carpus with each other, &c. but they are more like membranes than ligaments properly ſo called.

Some perform both the former offices; that of a membranous ligament to keep the bones together, and of a capſule to hold the mucilage. Theſe ſurround the orbicular articulations, as that of the humerus with the ſcapula, of the femur with the os innominatum, &c.

All the parts of theſe ligaments are not of equal thickneſs, ſo that they appear to be made up of two kinds of ligaments inſeparably united or glued together; one capſular, which ſurrounds the whole articulation, and ſeveral true ligaments extended to different diſtances over the other, and cloſely united to it. The name of orbicular ligaments is not general, becauſe it does not agree to thoſe of the bones of the tarſus, carpus, &c.

Anatomiſts do not rank among theſe, the membranous vagina belonging to the canal or ſinus in the ſuperior part of the humerus, which will be hereafter deſcribed.

Some are hid by the articulations themſelves, and by the capſular ligaments, as that belonging to the head of the femur, called improperly, ligamentum teres, and the crucial ligaments of the tibia.

The ligaments which ſerve to connect cartilages with bones, might be reckoned among the ſpecies of articular ligaments; and of theſe ſome are proper, as thoſe belonging to the ſemilunar cartilages of the knee, to the cartilaginous trochlea of the orbit, &c. Others are common, as all thoſe to which the inner articular cartilages are faſtened by their circumferences.

The other ligaments of the firſt claſs, or thoſe fixed to the bones without any relation to the articulation, are of two kinds.

Some of them are looſe, and ſerve only to limit the motions of the bones: ſuch as thoſe which tie the clavicles to the coracoïde apophyſes; thoſe that go from one clavicle to the other; and thoſe between the ſpinal apophyſes of the vertebres.

Some of them are tight, and ſtretched either between the parts of the ſame bone, as the ligaments between the acromion and coracoïde apophyſes, or between ſeveral bones united together without motion, as thoſe that are fixed by one extremity to the os ſacrum, and by the other to the os iſchium.

The ligaments of the ſecond general claſs, or thoſe which being fixed to bones or cartilages, are likewiſe of uſe to other parts, are of two kinds; ſome of them are fixed to the bones or cartilages only, and ſome are likewiſe fixed to other parts, or other parts are fixed to them.

Thoſe of the firſt kind ſerve chiefly to incloſe, check, limit, and ſtrengthen the muſcles and tendons, and ſometimes to change their directions.

The annular ligaments are of this kind, and they antiently had their name not ſo much from their figure, as from their uſe, which is much the ſame with that of the rings through which the reins of a horſe paſs; for it is after the ſame manner, that theſe ligaments bridle the tendons of many muſcles, and thus hinder them from ſtarting from their places in violent motions, and, in ſome circumſtances, change their directions.

The annular ligaments are either particular and ſimple, or common, and made up of ſeveral ſingle ones, as we ſhall ſee of thoſe of the carpus, thumb, &c. Some of them are like vaginæ or ſheaths, as thoſe on the internal or flat ſide of the firſt and ſecond phalanges of the fingers.

Some of them are only ſemi-annular, as that of the ſuperciliary ſciſſure of the orbit, when there is a ligament there, and that of the ſciſſure of the ſuperior coſta of the ſcapula.

To theſe might be referred the ligaments between the acromion and coracoïde apophyſis of the ſcapula, and between the os ſacrum and os iſchium, which have been already mentioned in the firſt claſs.

Thoſe of the other kind, which come under this ſecond claſs, comprehend the ligaments fixed to other parts as well as to bones, and theſe again are of two ſorts.

Some of them are fixed to one or more bones, with different degrees of tenſion, and ſerve on each ſide for the inſertion of muſcles, ſupplying, in that reſpect, the place of bones.

Of this kind are the interoſſeous ligaments of the fore-arm and leg, the obturator ligament, the ligament extended on each ſide of the humerus, from the cervix to the condyles, the poſterior and lateral ligaments of the cervix, and the ligamentary membranes of the poſterior foramina of the os ſacrum.

To theſe may be added, the ligaments commonly termed aponeuroſes; ſuch as thoſe of the temples, ſcapula, humerus, ulna, palm of the hand, thigh, leg, ſole of the foot, &c. all which ſhall be deſcribed in their proper places: and they may in general be termed aponeurotic ligaments, or ligamentary aponeuroſes, as ſepta, ligamentary vaginæ, &c. but they ought to be carefully diſtinguiſhed from the aponeurotic membranes of the muſcles and tendons, which ſhall be mentioned hereafter. The ligamentum ſuſpenſorium of the muſculus ſtylogloſſus belongs to this claſs.

Other differences of ligaments may be reduced from their conſiſtence, ſolidity, thickneſs, ſituation, and figure, as we ſhall demonſtrate.

Some ligaments are almoſt cartilaginous, as thoſe which ſurround the head of the radius, and the ſmall head of the ulna, a portion of the orbicular ligament of the head of the femur, and the annular vaginæ of the fingers.

Some of them have a particular elaſticity, by which they are capable of being extended by a ſufficient force, and of contracting again when left to themſelves. This elaſticity differs from that of cartilages; which laſt is hardly perceivable, but by compreſſing or bending them to a certain degree. It differs likewiſe from that of the other ligaments, being not only very conſiderable in living bodies, but even remains ſuch after death.

Of this kind are the ſupercilium of the cotyloïd cavity, the ligaments which tie the os hyoides to the ſtyloid apophyſis, the poſterior cervical ligament, the ligaments which connect the ſharp edges of the ſpinal proceſſes of the vertebres to one another, and thoſe ſeated at the baſes of theſe apophyſes next the great canal of the vertebres, eſpecially in the lumbar.

The arteries of ligaments are very conſpicuous after a tolerable injection, and the branches of their veins are ſometimes to be ſeen full of blood.

Such ligaments as form the ſides of cavities have numerous orifices of their arteries opening upon their internal ſurface, which keep it always moiſt: if we rub off that moiſture, and then preſs the ligament, we can ſee the liquor ouzing out from ſmall pores, and we can force thin liquors injected by the arteries into the cavities formed by ligaments.

Theſe exhaling arteries muſt have correſponding inhaling veins, otherwiſe the cavities would ſoon be too full of liquor.

The generality of anatomical writers aſſert, that ligaments are inſenſible, and have no nerves. But the violent pain felt on the leaſt motion of a joint attacked with the rheumatiſm or gout, the excruciating tortures occaſioned by inciſions of ligaments, and by a collection of acrimonious matter in a joint, ſufficiently prove that they are plentifully ſupplied with nerves.

The ligaments which ſerve to connect the moveable bones, commonly riſe from the conjunction of the epiphyſes of one bone, and fall into the ſame place of the other; or, where epiphyſes are not, they are fixed to the cervix, beyond the ſupercilia of the articulated bones: and after ſuch a manner in both caſes, as to include the articulation in a capſula or purſe, with this difference, depending on their different motions, that where the motion is only to be in two directions, the ligaments are ſtrongeſt on thoſe ſides, towards which the bones are not moved; and when a great variety of motions is deſigned to be allowed, the ligaments are weaker than in the former ſort of articulations, and are nearly of the ſame ſtrength all round.

Beſides theſe common circular ligaments of the joints, there are in ſeveral places particular ones, either for the firmer conjunction of the articulated bones, or for reſtraining and confining the motion to one ſide, ſuch as the croſs, and lateral ligaments of the knee, &c.

Ligaments are alſo of ſervice to the bones in ſeveral other reſpects; they ſupply the place of bones in ſeveral caſes to advantage: thus the parts in the pelvis are more ſafely ſupported below by ligaments, than they could have been by bone. The ligaments placed in the oval foramina of the oſſa innominata, and between the bones of the fore-arm and leg, afford convenient attachment to muſcles. Immoveable bones are more firmly connected by them; of which the conjunction of the os ſacrum and oſſa innominata is an example. They afford a ſocket for moveable bones to play in, as we likewiſe ſee in the articulation of the ſcapula with the humerus.

In all the moveable articulations, eſpecially of thoſe perſons who end their lives by ſudden or violent deaths, we find a viſcid liquor, in ſome meaſure reſembling a liquid mucilage, or the white of an egg well beat, which is commonly called ſynovia; a name given at firſt to the diſeaſe which affected this part.

This liquor is contained in the articulations and the ligamentary capſules, which hinder it from running out. It is furniſhed chiefly by ſmall bundles of glands more or leſs flat, and known by the name of mucilaginous glands, theſe being the organs through which this mucilage is conveyed to the blood. It may likely tranſude through the pores of the internal ſurface of the capſular ligaments, and partly is compoſed of an unctuous matter preſſed from the pinguious ſubſtances lying near the glands by the motion and friction of the articulated bones.

Theſe glands are more or leſs of a red colour, and of a very ſingular ſtructure, reſembling ſmall floating fringes of different thickneſs made up of follicular or veſicular grains, and furniſhed with a great number of veſſels running in very different directions. In ſome places they appear like diſtinct grains immoveably fixed. They are proportioned to the bones and joints, and lodged ſo as to be ſecured from violent frictions, chiefly near the edges of the capſules, or in particular cavities contrived or purpoſed to receive them.

The liquor continually furniſhed by theſe glands, mixed with that which tranſudes through the pores of the capſules, and perhaps with that which comes from the fat molecules, diffuſed through the articulated bones; and its uſe is to facilitate their motions to prevent them from bruiſing each other, and to keep their cartilages from drying or wearing out.

In the particular deſcription of each articulation we ſhall explain the differences of mucilaginous glands, with reſpect to their conformation, ſize, number, and ſituation.

The liquor, which principally ſerves to moiſten the ligaments and cartilages of the articulations, is ſupplied by theſe mucilaginous glands, which are commonly ſituated in the joint, after ſuch a manner as to be gently preſſed, but not deſtroyed by its motion. By this means, when there is the greateſt neceſſity for this liquor, that is, when the moſt frequent motions are performed, the greateſt quantity of it muſt be ſeparated. Theſe glands are ſoft and pappy, and are moſtly of the conglomerate kind, or a great quantity of ſmall glandules are wrapt up in one common membrane. Their excretory ducts are long, and hang looſe like ſo many fringes, within the articulation; which, by its motion and preſſure, prevents obſtructions in the body of the gland or its excretories, and promotes the return of this liquor, when fit to be taken up by the abſorbent veſſels, which muſt be done in the joints, as well as in the other cavities of the body; and at the ſame time the preſſure on the excretory ducts hinders a ſuperfluous ſecretion, while the fimbriated diſpoſition of theſe excretories does not allow any of the ſecreted liquor to paſs by a retrograde motion by theſe canals towards the glands, as Cowper has juſtly remarked.

Beſides theſe conglomerate glands, we meet ſometimes with ſmall ſimple folliculi, obſerved by Morgagni, that are full of liquor.

On preſſing any of theſe glands with the finger one can ſqueeze out of their excretories a mucilaginous liquor, which ſomewhat reſembles the white of an egg or ſerum, but is manifeſtly of a ſaltiſh taſte. It does not coagulate by heat, as the ſerum does; but turns firſt thinner, and when evaporated leaves only a thin ſalt film. Different ſalts have much the ſame effect on it as on the other juices of our body; for acids coagulate, and alkalies attenuate it. The quantity of this mucilage, conſtantly ſupplied, muſt be very conſiderable, ſince we ſee what a plentiful diſcharge of ſynovia follows a wound or ulcer of any joint, the mucilaginous liquor of which is extremely troubleſome.

The veſſels which ſupply liquors for the ſecretion of this mucilage, and the veins which return the blood remaining after the ſecretion, are to be ſeen without any preparation; but after a tolerable injection of the arteries, the glands are covered with them.

In a ſound ſtate we are not conſcious of any ſenſibility in theſe glands; but in ſome caſes when they inflame and ſuppurate, the moſt racking pain is felt in them: a melancholy though ſure proof that they have nerves.

Theſe mucilaginous glands are commonly lodged in a cellular ſubſtance; which is alſo to be obſerved in other parts of the capſule, formed by the ligaments of the articulation, and contains a pinguious matter, that muſt neceſſarily be attenuated and forced through the including membranes into the cavity of the joint by the preſſure which it ſuffers from the moving bones.

If then the oil is conveyed from this cellular ſubſtance, and if the attenuated marrow paſſes from the cancelli of the bones by the large pores near their extremities, or in their cavities, and tranſudes through the cartilages into the articulations, which it may when aſſiſted by the conſtant heat and action of the body, more eaſily do, than when it eſcapes through the compact ſubſtance of the bones in a ſkeleton: if this oil is ſent to a joint, and incorporated with the mucilage, and with the fine lymph that is conſtantly ouzing out at the extremities of the ſmall arteries diſtributed to the ligaments, one of the fitteſt liniments imaginable muſt be produced; for the mucus, diluted by the lymph, contributes greatly to its lubricity, and the oil preſerves it from hardening. How well ſuch a mixture ſerves the purpoſe it is deſigned for, Boyle tells us he experienced in working the air-pump; for the ſucker could be moved with much leſs force after being moiſtened with water and oil than when he uſed either one or the other of theſe liquors. And no doubt every one at firſt view will allow the diluted mucilage to be much preferable to ſimple water. The ſynovia, as this liquor is compoſed of oil and mucilage, will therefore, while in a ſound ſtate, effectually preſerve all the parts concerned in the articulation ſoft and flexible, and will make them ſlide eaſily on each other, by which their mutual detrition and over-heating may be prevented, in the manner daily practiſed in coach and cart wheels, by lubricating them with greaſe and tar.

After the liquor of the articulations becomes too thin and unſerviceable, by being conſtantly pounded and rubbed between the moving bones, it is re-aſſumed into the maſs of blood by the abſorbent veſſels.

When the ſynovia is not rubbed between the bones; and ſometimes when the head of a bone has been a long time out of its cavity, this liquor fills up the place of the bone, and hinders its reduction; or if a joint continues long unmoved, the ſynovia cements the bones, and occaſions a true anchyloſis. If this fluid becomes acrimonious, as frequently happens in the venereal diſeaſe, ſcurvy, and ſcrophula, it erodes the cartilages and bones. If ſeparated in too ſmall a quantity, the joint becomes ſtiff, and when with difficulty it is moved, a cracking noiſe is heard, as people advanced in years frequently experience. If the mucilage and lymph are diſpoſed in too great a quantity, and the abſorbent veſſels do not perform their office ſufficiently, they may occaſion a dropſy of the joints. From this ſame cauſe alſo the ligaments are often ſo much relaxed, as to make the conjunction of the bones very weak: whence ariſe luxations from an internal cauſe, which are eaſily reduced, but difficult to be cured. Frequently, when ſuch a ſuperfluous quantity of this liquor is pent up, it becomes very acrid, and occaſions a train of bad ſymptoms; ſuch as ſwelling and pain of the joints, ſinuous ulcers, rotten bones, immobility of the joints, an atrophy of the whole body, hectic fevers, &c.

OSTEOGRAPHY.

THE word ſkeleton is uſed by anatomiſts to ſignify the bones of animals connected together, after the integuments, muſcles, viſcera, glands, nerves, and veſſels, are removed.

The human ſkeleton is divided into the head, trunk, ſuperior and inferior extremities.

The head is all that globular part which is ſituated above the firſt vertebre of the neck, and therefore comprehends the ſkull, and the bones of the face.

The ſkull forms a vaulted cavity for lodging and defending the brain and cerebellum with their membranes, veſſels, and nerves. Its cavity is proportionable to its contents, hence it is neither ſo broad or deep at its fore part, in which the anterior lobes of the brain are lodged, as it is behind, where the large poſterior lobes of the brain, and the whole cerebellum, are contained. Its roundiſh figure, which renders it more capacious, and better able to defend its contents from external injuries, is chiefly owing to the equal preſſure of theſe contained parts, as they grow and increaſe before it is entirely oſſified: the ſides are however ſomewhat depreſſed by the powerful action of the temporal muſcles, which hinder the uniform protruſion of the bones. In children, whoſe muſcles have not acted much, and conſequently have not had great effect on the bones, this depreſſion is not ſo remarkable; and, on that account the head in them is much rounder than in adults. Theſe natural cauſes differently diſpoſed in different ſubjects, cauſe a great variety in the ſhapes of ſkulls, which is ſtill further encreaſed by the different management of the heads of infants, as Veſalius obſerves. This flatneſs of the ſides of the ſkull is attended with two advantages; our ſphere of viſion is enlarged, and our ears are more advantageouſly ſituated for receiving a greater quantity of ſound, and are leſs expoſed to injuries.

The external ſurface of the upper part of the ſkull is very ſmooth, being only covered with the perioſteum, the common covering of all bones, in this part called the pericranium, the thin frontal and occipital muſcles, their tendinous aponeuroſes, and with the common integuments of the body: the external ſurface of its lower part has numerous ridges, depreſſions, and holes, which ſerve for the attachment of the muſcles connected thereto, and allow a ſafe paſſage for its veſſels and nerves.

The internal ſurface is ſmooth, except where the veſſels of the dura mater have made indentations therein, before the bones were perfectly oſſified. Hence in performing the operation of the trepan, ſurgeons ſhould ſaw through and raiſe the bone with the utmoſt caution, leaſt they wound theſe veſſels. In ſome ſkulls, in this part we alſo ſee ſeveral pits of different ſizes and ſhapes, which ſeem to be formed from the luxuriancy of ſome particular part of the brain; and in theſe places the ſkull is commonly ſo thin, that it is almoſt, nay, ſometimes, quite diaphanous, the two tables being cloſely compacted without the intervention of the diploe, the want whereof is ſupplied by veſſels larger than common, which paſs from the dura mater into a great many ſmall foramina obſervable in the pits, which afford another reaſon why ſurgeons ought to ſaw cautiouſly and ſlowly through the external table of the ſkull, in performing the operation of the trepan, ſince, in ſuch a patient, the dura mater and brain may be injured, before the inſtrument has penetrated the common depth of a table of the ſkull. The internal baſe of the ſkull is very unequal, for containing the ſeveral parts and appendages of the brain and cerebellum, and allowing paſſage and defence to the veſſels and nerves that enter or paſs out from theſe parts.

The ſkull is formed by an aſſemblage of eight bones, each compoſed of two laminæ or tables, one of which is external, and the other internal. This latter is called vitrea, becauſe it is thin, and friable as glaſs. Between theſe two tables there is a ſpongy ſubſtance called the diploe, which is not of the ſame thickneſs thro' the whole ſkull; for in ſome parts it runs but thin, and in others it is not to be met with at all. It is much of the ſame texture as the cancelli of the other bones, and contains likewiſe a medullary juice, with numerous ramifications of ſanguineous veſſels ſpread on them: but ſometimes in old ſkulls the diploe is ſo obliterated, that ſcarce any veſtiges are left. Often a collection of matter is found in the diploe, either from internal or external cauſes.

The os frontis forms the whole fore-part of the vault; the two oſſa parietalia form the upper and middle part of it; the oſſa temporum compoſe the lower part of the ſides; the os occipitis makes the whole hinder part, and ſome of the baſe; the os ethmoides is placed in the fore-part of the baſe; and the os ſphenoides in the middle thereof.

Theſe bones are connected together by five ſutures; the names of which are the coronal, lamdoidal, ſagittal, and the two ſquamous.

The coronal ſuture is extended over the head, from within an inch, or ſo, of the external canthus of one eye, to the like diſtance from the other; which being near the place where the ancients wore their laureat crowns or garlands, this ſuture from hence got its name. Though the indentations of this ſuture are conſpicuous in its upper part, yet an inch or more of its end on each ſide has none of them, being ſquamous and ſmooth there.

The lambdoidal ſuture begins ſome way below, and farther back than the vertex or crown of the head: whence its two legs are ſtretched obliquely downwards, and to each ſide in the form of the Greek letter Λ, and are now generally ſaid to extend themſelves to the baſe of the ſkull: but formerly anatomiſts reckoned the proper lambdoidal ſuture to terminate at the ſquamous ſutures, and what is extended at an angle down from each ſide, where the indentations are leſs conſpicuous than in the upper part of the ſuture they called the additamentum of the lambdoidal ſuture.

This ſuture is ſometimes very irregular, being made up of a great number of ſmall ſutures, which ſurround ſo many little bones that are generally larger and more conſpicuous on the external ſurface of the ſkull, than internally. Theſe bones are generally called triquetra, or wormiana; but ſome other name ought to be given them, for they are not always of a triangular figure, and have been deſcribed by older anatomiſts than Olaus Wormius.

Their formation is owing either to a greater number of points of oſſification than uſual, or to the bones of the ſkull not extending their oſſification far enough, or quick enough; whence the unoſſified interſtice begins a ſeparate oſſification in one, or perhaps more points, and, being extended, forms ſo many diſtinct bones, as there were points, which are indented into the other large bones, and into each other. Oſſa triquetra have been found in other ſutures, and ſometimes only in one table of the ſkull, by Ruyſch, Veſalius, Pauw, Hunauld, Le Sue, and others, which confirms the truth of the above account of their formation.

The ſagittal ſuture is placed longitudinally in the middle of the upper part of the ſkull, and commonly terminates at the middle of the coronal, and of the lambdoid ſutures, between which it is ſaid to be placed like an arrow between the ſtring and the bow. However, this ſuture is frequently continued through the middle of the os frontis, down to the root of the noſe, which is ſaid by Riolan, to happen oftener in women than in men; but others, as Veſalius, alledge, that it is to be met with more frequently in male ſkulls. Pauw, Veſalius, and Heiſter, have delineated and deſcribed the ſagittal ſuture, ſometimes dividing the occipital bone as far down as the great hole thro' which the medulla ſpinalis paſſes.

In ſome old ſkulls there is ſcarce any veſtige of any of the three ſutures now deſcribed. In other heads, one or two of the ſutures only diſappear, but there appears no reaſon for thinking them diſpoſed in ſuch different manners in ſkulls of different ſhapes, as Hippocrates and Galen alledge they are.

The ſquamous agglutinations, or falſe ſutures, are one on each ſide, a little above the ear, of a ſemi-circular figure, formed by the lower lapping (like one ſcat on another) of the upper-part of the temporal bones, on the lower part of the parietal, where in both bones there are a great many ſmall riſings and furrows, which are indented into each other; though theſe inequalities do not appear till the bones are ſeparated. In ſome ſkulls, indeed, the indentations here are as conſpicuous externally as in other ſutures; and what is commonly called the poſterior part of this ſquamous ſuture, always has the evident ſerrated form, and therefore is reckoned by Columbus, and Dionis as a diſtinct ſuture, under the name of the additamentum poſterius ſuturæ ſquamoſæ. Le Sue has ſeen two ſquamous ſutures on the ſame temple, with a ſemi-circular piece of bone between them.

We ought here to remark, that the true ſquamous ſuture is not confined to the conjunction of the temporal and parietal bones, but is made uſe of to join all the edges of the bones on which each temporal muſcle is placed; for the two parts of the ſphenoidal ſuture, which are continued from the anterior end of the common ſquamous ſuture juſt now deſcribed, of which one runs perpendicularly downwards, and the other horizontally forwards, and alſo the lower-part of the coronal ſuture already taken notice of, may be juſtly ſaid to appertain to the ſquamous ſuture. The manner in which this ſort of ſuture is formed at theſe places, is, in the opinion of the celebrated Monro, that by the action of the ſtrong temporal muſcles on one ſide, and by the preſſure of the brain on the other, the bones are ſo thin, that they have not ſurfaces large enough oppoſed to each other to ſtop the extenſion of their fibres in length, and thus cauſe the common ſerrated appearance of ſutures before explained; but the narrow edge of the one bone ſlides over the other. The ſquamous form is alſo more convenient here, becauſe ſuch thin edges of bones when accurately applied one to another, have ſcarce any rough ſurface to obſtruct or hurt the muſcle in its contraction, which is ſtill further provided for, by the manner of laying theſe edges on each other; for in viewing their out-ſide, we ſee the temporal bones covering the ſphenoidal and parietal, and this laſt ſupporting the ſphenoidal, while both mount on the frontal; from which diſpoſition it is evident, that while the temporal muſcle is contracting, which is the only time it preſſes ſtrongly in its motion on the bones, its fibres ſlide eaſily over the external edges. Another advantage ſtill in this is, that all this bony part is made ſtronger by the bones thus ſupporting each other.

The bones of the ſkull are joined to thoſe of the face, by ſchyndeleſis and ſutures. The ſchyndeleſis is in the partition of the noſe. The ſutures ſaid to be common to the cranium and face are five, viz. the ethmoidal, ſphenoidal, tranſverſe, and two zygomatic. Parts, however, of theſe ſutures, are at the junction of only the bones of the ſkull.

The ethmoidal and ſphenoidal ſutures ſurround the bones of theſe names, and in ſome places help to make up other ſutures, particularly the ſquamous and tranſverſe; and in other parts there is but one ſuture common to theſe two bones.

The tranſverſe ſuture is extended quite acroſs the face, from the external canthus of one orbit to the ſame place of the other, by ſinking from the canthus down the outſide of the orbit to its bottom, then mounting on its inſide, it is continued from the root of the noſe, down the internal part of the other orbit, and riſes up again on its outſide to the other canthus. It may be here remarked, that there are ſome interruptions of this ſuture in the courſe I have deſcribed, for the bones are not contiguous every where, but are ſeparated, to leave holes and apertures, which will be ſpoken of hereafter.

The zygomatic ſutures are one on each ſide, being ſhort, and ſlanting from above obliquely downwards and backwards, to join a proceſs of the cheek bone to one of the temporal bones, which advances towards the face; ſo that the two proceſſes thus united, form a ſort of bridge, under which the temporal muſcle paſſes; on which account the proceſſes and ſuture joining them, have been called zygomatic.

It muſt be obſerved, that the indentations of the ſutures do not appear on the inſide of the cranium, by much ſo ſtrong as on the outſide; but the bones ſeem almoſt joined in a ſtreight line: nay, in ſome ſkulls, the internal ſurface is found intire, while the ſutures are manifeſt without; which may poſſibly be owing to the leſs extent of the concave, than of the convex ſurface of the cranium, whereby the fibres of the internal ſide would be ſtretched farther out at the edges of the bones, than the exterior ones, if they were not reſiſted. The reſiſtances are the fibres of the oppoſite bone, the parts within the ſkull, and the diploe, of which the laſt being the weakeſt, the moſt advanced fibres run into it, and leave the contiguous edges equal, and more ready to unite: whereas the ſerrated edges of the external table have ſpace enough for their admiſſion between the fibres of the oppoſite bone, and therefore remain of the indented form, and are leſs liable to the concretion, whereby the ſutures are obliterated, as Hunauld obſerves. By this mechaniſm, there is no riſk of the ſharp points of the bones growing inwards, ſince the external dentated fibres of each of the conjoined bones reſt on the internal ſmooth edged table of the other; and external forces applied to theſe parts are ſtrongly reſiſted, becauſe the ſutures cannot yield, unleſs the ſerrated edges of one bone, and the plain internal plate of the other are broken.

The advantages of the ſutures of the cranium are: 1. That this capſula is more eaſily formed and extended into a ſpherical figure, than if it had been one continued bone. 2. That the bones which are at ſome diſtance from each other at birth, might then yield, and allow the head a change of ſhape, accommodated to the paſſage it is engaged in. Whence in hard labours the bones of the cranium, inſtead of being only brought into contact, are ſometimes made to mount one on another. 3. It is alledged, that through the ſutures there is a tranſpiration of ſteams from the brain, which was the old doctrine, or ſome communication of the veſſels without, and of thoſe within the ſkull, larger here than in any other part of the cranium, according to ſome moderns; and therefore cupping glaſſes, fomentations, cataplaſms, cephalic plaiſters, bliſters, are applied, and iſſues are coroded or cut in the head, at thoſe places where the ſutures are longeſt in forming, and where the connection of the bones is afterwards looſe, for the cure of a phrenſy, madneſs, inveterate head-ach, epilepſy, apoplexy, and other diſeaſes of the head. The favourers of the doctrine of tranſpiration, or communication of the veſſels at the ſutures, endeavour to ſupport it by obſervations of perſons ſubject to head-achs, which cauſe death from the ſutures being too cloſely united. 4. That the dura mater may be more firmly ſuſpended by its proceſſes, which inſinuate themſelves into this conjunction of the bones; for doing this equally, and where the greateſt neceſſity of adheſion is, the ſutures are diſpoſed at nearly equal diſtances, and the large reſervoirs of blood, the ſinuſes, are under or near them. 5. That fractures might be prevented from reaching ſo far as they would in a continued bony ſubſtance. 6. That the connection at the ſutures being capable of yielding, the bones might be allowed to ſeparate, which has given great relief to patients from the violent ſymptoms they had before this ſeparation happened: and it ſeems reaſonable to believe, that the opening of the ſutures was of great benefit to ſeveral others, who were rather judged to have been hurt by it; for we muſt think, that the conſequences of ſuch a force acting on the brain, as was capable of thruſting the bones aſunder, muſt have been fatal, unleſs it had been thus yielded to.

Having gone through the general ſtructure of the ſkull, we next proceed to conſider the ſeveral bones in particular.

The Os Frontis has its name from its being the only bone of that part of the face we call the forehead, though it reaches a good deal further. It has ſome reſemblance in ſhape to the ſhell of the concha bivalvis, commonly called the cockle; for the greateſt part of it is convex externally, and concave internally, with a ſerrated circular edge; while the ſmaller part has proceſſes and depreſſions, which make it of an irregular figure.

The external ſurface of the os frontis is ſmooth at its upper convex part; but ſeveral proceſſes and cavities are obſervable below: for, at each angle of the orbit, the bone projects out, to form four proceſſes, two internal and as many external; which, from their ſituation, may well enough be named angular. Between the internal and external angular proceſſes of each ſide, an arched ridge is extended, on which the eye-brows are placed. Very little above the internal end of each of theſe ſuperciliary ridges, a protuberance may be remarked in moſt ſkulls, where there are large cavities, called ſinuſſes, within the bone; of which we ſhall treat hereafter. Betwixt the internal angular proceſſes, a ſmall proceſs ariſes, which forms ſome ſhare of the noſe, and thence is named naſal. Some have obſerved a protuberant part on the edge of the bone behind each external angular proceſs, which they call temporal proceſſes; but theſe are inconſiderable. From the upper part of the ſuperciliary ridges, the frontal bone runs a great way backwards; which parts may juſtly be called orbitar proceſſes. Theſe, contrary to the reſt of this bone, are concave externally, for receiving the globes of the eyes, with their muſcles, fat, &c.

In each of the orbitar proceſſes, behind the middle of the ſuperciliary ridges, a conſiderable ſinuoſity is obſerved, where the glandula innominata Galeni, or lachrymalis, is lodged. Behind each internal angular proceſs, a ſmall pit may be remarked, where the cartilaginous pully of the muſculus obliquus major of the eye is fixed. Betwixt the two orbitar proceſſes, there is a large diſcontinuation of the bone, into which the cribriform part of the os ethmoides is incaſed. The frontal bone has frequently little caverns formed in it here, where it is joined to the ethmoid bone. Behind each external angular proceſs, the ſurface of the frontal bone is conſiderably depreſſed where part of the temporal muſcle is placed.

The foramina, or holes obſervable on the external ſurface of the frontal bone, are three in each ſide. One in each ſuperciliary ridge, a little removed from the middle towards the noſe, through which a twig of the ophthalmic branch of the fifth pair of nerves paſſes out of the orbit, with a ſmall artery from the internal carotid, to be diſtributed to the integuments and muſcles of the forehead. Theſe veſſels, in ſome ſkulls, make furrows in the os frontis, eſpecially in the bones of children, as has alſo been obſerved by Ruyſch of another conſiderable veſſel of this bone near its middle, and therefore we ought to beware of tranſverſe inciſions on either ſide of the os frontis, which may either open the veſſels or hurt the nerves, while they are yet in part within the bone; for when veſſels are thus wounded, it is difficult to ſtop the hæmorrhage; becauſe the adheſion of part of the artery to the bone hinders its contraction, and conſequently ſtyptics can have little effect; the ſides of the furrow keep off compreſſing ſubſtances from the artery; and we could wiſh to ſhun cauteries or eſcharotics, becauſe they make the bones carious; and nerves, when thus hurt, ſometimes produce violent ſymptoms. But, to return to the ſuperciliary foramina, we muſt remark, that often a notch only is to be ſeen, nay, in ſome ſkulls, ſcarce a veſtige of this is left; in others, both hole and notch are obſervable, when the nerve and artery run ſeparately. Frequently a hole is found on one ſide, and a notch on the other; at other times two holes are to be ſeen; or there is a common hole without, and two diſtinct entries internally. The reaſon of this variety of a hole, notch, depreſſion, or ſmoothneſs in the ſuperciliary ridge, is the different length and tenſion of the nerves and veſſels; the ſhorter they are, the more they are ſunk in the bone as it grows. Near the middle of the inſide of each orbit, hard by, or in the tranſverſe ſuture, there is a ſmall hole for the paſſage of the naſal twig of the firſt branch of the fifth pair of nerves, and a branch of the ophthalmic artery. This hole is ſometimes entirely formed in the os frontis; in other ſkulls, the ſides of it are compoſed of this laſt bone, and of the os planum. It is commonly known by the name of orbitarium internum, though anterius ſhould be added, becauſe of the next, which is commonly omitted. This, which may be called orbitarium internum poſterius, is ſuch another as the former; only ſmaller, and about an inch deeper in the orbit: through it a ſmall branch of the ocular artery paſſes to the noſe. Beſides theſe ſix, there are a great number of ſmall holes obſervable on the outer ſurface of this bone, particularly in the two protuberances above the eye-brows. Moſt of theſe penetrate no further than the ſinuſſes, or than the diploe if the ſinuſſes are wanting; though ſometimes this bone has been obſerved ſo perforated by a vaſt number of theſe ſmall holes, that placed between the eye and a clear light, it appeared like a ſieve. In the orbit of the generality of ſkeletons, we may obſerve one, two, or more holes, which will allow a paſſage to a hog's briſtle through the ſkull. The place, ſize, and number of theſe are however uncertain: they generally ſerve for the tranſmiſſion of ſmall arteries or nerves.

The internal ſurface of the os frontis is concave, except at the orbitar proceſſes, which are convex, to ſupport the anterior lobes of the brain. This ſurface is not ſo ſmooth as the external; for the larger branches of the arteries of the dura mater make ſome furrows in its ſides and back parts. The ſinuoſities, from the luxuriant riſings of the brain, mentioned when deſcribing the general ſtructure of the ſkull, are often very obſervable on its upper part; and its lower and fore parts are marked with the contorſions of the anterior lobes of the brain. Through the middle of this internal ſurface, where always in children, and ſometimes in old people, the bone is divided, either a ridge ſtands out, to which the upper edge of the falx is faſtened, or a furrow runs, in which the upper ſide of the ſuperior longitudinal ſinus is lodged; on both theſe accounts chirurgical authors juſtly diſapprove of the application of the trepan here. The reaſon of this difference in ſkulls, is alledged by ſome authors to be this, that in thin ſkulls the ridge ſtrengthens the bones, and in thick ones there is no occaſion for it. To this way of accounting for this phenomenon, it may juſtly be objected, that generally very thick ſkulls have a large ſpine here, and frequently thin ones only have a furrow. Perhaps this variety may be owing to the different times of a compleat oſſification of thoſe parts in different ſubjects. For if the two ſides of this bone meet before they arrive at their utmoſt extent of growth, they unite very firmly, and all their fibres endeavour to ſtretch themſelves out where the leaſt reſiſtance is, that is, between the hemiſpheres of the brain. To ſupport this reaſoning, we may remark that thoſe adults, whoſe frontal bone is divided by the ſagittal ſuture, never have a ridge in this place.

Immediately at the root of this ridge or furrow, there is a ſmall hole, which ſometimes pierces through the firſt table, and, in other ſkulls, opens into the ſuperior ſinus of the ethmoid bone within the noſe. In it, according to Morgagni, a little proceſs of the falx is lodged, and a ſmall artery, and ſometimes a vein runs; and the ſuperior longitudinal ſinus begins here. This hole, however, is often not entirely proper to the os frontis; for, in ſeveral ſkulls, the lower part of it is formed in the upper part of the baſe of the cryſta galli, which is a proceſs of the ethmoid bone.

The os frontis is compoſed of two tables, and an intermediate diploe, as the other bones of the ſkull are, and, in a middle degree of thickneſs between the os occipitis and the parietal bones; is pretty equally denſe all through, except at the orbitar proceſſes, where by the action of the eye on one ſide, and the preſſure of the lobes of the brain of the other, it is made extremely thin and diaphanous, and the meditullium is entirely obliterated. Since in this place there is ſo weak a defence for the brain, the reaſon appears why fencers eſteem a puſh in the eye mortal.

The diploe is alſo exhauſted in that part above the eye-brows, where the two tables of the bones ſeparate, by the external being protruded outwards, to form two large cavities, called frontal ſinuſſes: theſe are divided by a middle perpendicular bony partition. Their capacities in the ſame ſubject are ſeldom equal; in ſome the right, in others the left is largeſt. And in different bones their ſize is as inconſtant, nay, in ſome, they have been found entirely wanting; which oftener happens in ſuch as have flat foreheads, and whoſe ſagittal ſuture is continued down to the noſe, than in others. In ſome ſkulls, beſides the large perpendicular ſeptum, there are ſeveral bony pillars, or ſhort partitions, found in each ſinus; in others theſe are wanting. For the moſt part the ſeptum is entire; at other times it is diſcontinued, and the two ſinuſſes communicate. When the ſinuſſes are ſeen in ſuch ſkulls as have the frontal bone divided by the ſagittal ſuture, the partition dividing theſe cavities is evidently compoſed of two plates, which eaſily ſeparate. Each ſinus commonly opens by a roundiſh ſmall hole, at the inner and lower part of the internal angular proceſſes, into a ſinus formed at the noſe, at the upper and back part of the os unguis; near to which there are alſo ſome other ſmall ſinuſſes of this bone, the greater part of which open ſeparately nearer the ſeptum narium, and often terminate in the ſame common canal with the large ones.

In a natural and ſound ſtate, theſe cavities are of conſiderable advantage; for the organ of ſmelling being thus enlarged, the effluvia of odorous bodies more difficultly eſcape it; and their impreſſions being more numerous, are therefore ſtronger, and affect the organ more.

That odorous particles may be applied to the membrane of the ſinuſſes, is evident from the pain felt in this part of the forehead, when the effluvia of volatile ſpirits, or of ſtrong aromatics are drawn up into the noſe by a quick inſpiration. Theſe and the other cavities which open into the noſe, encreaſe the ſound of our voice, and render it more melodious, by ſerving as ſo many vaults to reſound the notes. Hence people labouring under a coryza, or a ſtoppage of the noſe from any other cauſe, when they are by the vulgar ſaid to ſpeak through their noſe, have ſuch a diſagreeable harſh voice. The liquor ſeparated in the membrane of theſe ſinuſſes, trickles down on the membrane of the noſe to keep it moiſt.

The upper circular part of the os frontis is joined to the parietal bones, from one temple to the other, by the coronal ſuture. From the termination of the coronal ſuture, to the external angular proceſſes, this bone is connected to the ſphenoid by the ſphenoidal ſuture. At the external canthi of the eyes, its angular proceſſes are joined by the tranverſe ſuture to the cheek bones, to which it adheres one third down the outſide of the orbits; whence to the bottom of theſe cavities, and a little up on their internal ſides, theſe orbitar proceſſes are connected to the ſphenoidal bone by that ſame ſuture. In ſome few ſkulls, however, a diſcontinuation of theſe two bones appears at the upper part of the long ſlit, near the bottom of the orbit. On the inſide of each orbit, the orbitar proceſs is indented between the cribriform part of the ethmoid bone, and the os planum and unguis. The tranverſe ſuture afterwards joins the frontal bone to the ſuperior naſal proceſſes of the oſſa maxillaria ſuperiora, and to the naſal bones. And laſtly, its naſal proceſs is connected to the naſal lamella of the ethmoid bone.

The frontal bone ſerves to defend and ſupport the anterior lobes of the brain. It forms a conſiderable part of the cavities that contain the globes of the eyes, helps to make up the ſeptum narium, organ of ſmelling, &c. From the deſcription of the ſeveral parts, the other uſes of this bone are evident.

In a full grown child, the frontal bone is divided through the middle;

dle; the ſuperciliary holes are not formed; often a ſmall round piece of each orbitar proceſs, behind the ſuperciliary ridge, is not oſſified, and there is no ſinus to be ſeen within its ſubſtance.

Each of the two PARIETAL BONES which ſerve as walls to the encephalon, is an irregular ſquare; its upper and fore ſides being longer than the one behind or below. The inferior ſide is a concave arch, the middle part receiving the upper round part of the temporal bone. The angle formed by this upper ſide, and the fore one, is ſo extended, as to have the appearance of a proceſs.

The external ſurface of each parietal bone is convex. Upon it, ſomewhat below the middle height of the bone, there is a tranverſe arched ridge, of a whiter colour generally than any other part of the bone; from which, in bones that have ſtrong prints of muſcles, we ſee a great many converging furrows, like ſo many rays drawn from a circumference towards a center. From this ridge of each bone the temporal muſcle riſes, and, by the preſſure of its fibres, occaſions the furrows juſt now mentioned. Below theſe we obſerve, near the ſemicircular edges, a great many riſings and depreſſions, which are joined to like inequalities on the inſide of the temporal bone, to form the ſquamous ſuture. The temporal bone may, therefore, ſerve here as a buttreſs, to prevent the lower ſide of the parietal from ſtarting outwards when its upper part is depreſſed or ſtruck, as Hunauld obſerves.

Near the upper ſides of theſe bones, towards the hind part, is a ſmall hole in each, through which a vein paſſes from the integuments of the head to the longitudinal ſinus. Sometimes a branch of the temporal artery paſſes through this hole, to be diſtributed to the upper part of the falx, and to the dura mater of its ſides, where it has frequent anaſtomoſes with the branches of the arteries derived from the external carotids, which commonly have the name of the arteries of the dura mater, and with the branches of the internal carotids which ſerve the falx. In ſeveral ſkulls, one of the oſſa parietalia has not this hole; in others, there are two in one bone, and in ſome none in either. Moſt frequently this hole is through both tables; at other times the external table only is perforated. The knowledge of the courſe of theſe veſſels may be of uſe to ſurgeons, when they make any inciſion near this part of the head, leſt, if the veſſels are raſhly cut near the hole, they ſhrink within the ſubſtance of the bone, and ſo cauſe an obſtinate hemorrhage, which neither ligatures nor medicines can ſtop.

On the inner concave ſurface of the parietal bones, we ſee a great many deep furrows, diſpoſed ſomewhat like the branches of trees. The furrows are largeſt and deepeſt at the lower edge of each parietal bone, eſpecially near its anterior angle, where ſometimes a full canal is formed. They afterwards divide into ſmall furrows, in their progreſs upwards. In ſome ſkulls, a large furrow begins at the hole near the upper edge, and divides into branches which join with thoſe which come upwards, ſhewing the communications of the upper and lower veſſels of the dura mater. In theſe furrows we frequently ſee paſſages into the diploe, and ſometimes canals going off; which allow a ſmall probe to paſs ſome inches into the bony ſubſtance. Cowper affirms, that he has obſerved theſe canals piercing the bone towards the occiput. On the inſide of the upper edge of the parietal bones, there is a large ſinuoſity, frequently larger in the bone of one ſide than in the other, where the upper part of the falx is faſtened, and the ſuperior longitudinal ſinus is lodged. Generally part of the lateral ſinuſſes makes a depreſſion near the angle formed by the lower and poſterior ſides of theſe bones; and the pits made by the prominent parts of the brain, are to be ſeen in no part of the ſkull more frequent, or more conſiderable, than in the internal ſurface of the parietal bones.

The parietal bones are amongſt the thinneſt bones of the ſkull; but enjoy the general ſtructure of two tables and diploe the compleateſt, and are the moſt equal and ſmooth.

Theſe bones are joined at their foreſide to the os frontis by the coronal ſuture; at their long inferior angles to the ſphenoid bone, by part of the ſuture of this name; at their lower edge to the temporal bones by the ſquamous ſuture, and its poſterior addition; behind, to the occipital, or oſſa triquetra, by the lambdoid ſuture; and above, to one another, by the ſagittal ſuture.

They have no particular uſes beſides thoſe mentioned in the deſcription of their ſeveral parts, except what are included in the account of the general ſtructure of the ſkull.

In a child born at the full time, none of the ſides of this bone are completed, and there never is a hole in the oſſified part thereof near the ſagittal ſuture.

The large unoſſified ligamentous part of the ſkull obſervable between the parietal bones, and the middle of the divided frontal bone of new born children, called by the vulgar the open of the head, was imagined by the antients to ſerve for the evacuation of the ſuperfluous moiſture of the brain, and therefore they named it bregma, or the fountain, ſometimes adding the epithet pulſatilis, or beating, on account of the pulſation of the brain felt through this flexible ligamento-cartilaginous ſubſtance. Hence very frequently the parietal bones are called oſſa bregmatis.

The upper middle part of the head of a child, in a natural birth, preſenting itſelf firſt at the mouth of the womb, an accoucheur may reach the bregma with his finger, when the mouth of the womb is a little opened. If the bregma is ſtretched, and the pulſation of the brain is felt through it, the child is certainly alive; but if it is ſhrivelled and flaccid, without any obſervable pulſation therein, there is reaſon to ſuſpect the child to be very weak, or dead. Thoſe who practiſe midwifry ſhould, therefore, examine the ſtate of this bone accurately.

All the bregma is generally oſſified before ſeven years of age. Bartholine, Diemerbroeck, and Kirkringius ſay, they have obſerved it unoſſified in adults: and phyſicians, who order the application of medicines at the meeting of the coronal and ſagittal ſutures, ſeem yet to think that a derivation of noxious humours from the encephalon is more eaſily procured at this part than at any other of the ſkull.

The temporal bones are each of them ſmooth, and have a very thin ſemicircular edge; which from the manner of its connection with the neighbouring bones, is diſtinguiſhed by the name of the ſquamous bone. Behind this, the upper part is thicker, and more unequal, and is ſometimes deſcribed as a diſtinct part, under the name of the mammillary part. Towards the baſe of the ſkull, the temporal bone appears very irregular and unequal; and this part, inſtead of being broad and placed perpendicularly, as the others are, is contracted into an oblong, very hard ſubſtance, extended horizontally forwards and inwards, which in its progreſs becomes ſmaller, and is commonly called os petroſum.

Three external proceſſes of each temporal bone are generally deſcribed. The firſt placed at the lower and hind part of the bone, from its reſemblance to a nipple, is called maſtoides, or mammillaris. It is not ſolid, but within is compoſed of cancelli, or ſmall cells, which have a communication with the large cavity of the ear, the drum; and therefore ſounds being multiplied in this vaulted labyrinth, are increaſed, before they are applied to the immediate organ of hearing. Into the maſtoid proceſs, the ſterno-maſtoideus muſcle is inſerted; and to its back part, where the ſurface is rough, the trachelo-maſtoideus, and part of the ſplenius, are fixed. About an inch farther forward, the ſecond proceſs begins to riſe out from the bone, and having its origin continued obliquely downwards and forwards for ſome way, it becomes ſmaller, and is ſtretched forwards to join with the cheek bone; they together forming the bony yoke under which the temporal muſcle paſſes. Hence this proceſs has been named zygomatic. Its upper edge has the ſtrong aponeuroſis of the temporal muſcle fixed into it; and its lower part gives riſe to a ſhare of the maſſeter. The fore part of the baſe of this proceſs is an oblong tubercle, which in a recent ſubject is covered with a ſmooth poliſhed cartilage, continued from that which lines the cavity immediately behind the tubercle. From the under craggy part of the temporal bone, the third proceſs ſtands out obliquely forwards. The ſhape of it is generally ſaid to reſemble the ancient ſtylus ſcriptorius; and therefore it is called the ſtyloid proceſs. Some authors however contend, that it ought to be named ſteloid, from its being more like to a pillar. Several muſcles have their origin from this proceſs, and borrow one half of their name from it, as ſtylo-gloſſus, ſtylo-hyoideus, ſtylo-pharyngeus: to it a ligament of the os hyoides is ſometimes fixed; and another is extended from it to the inſide of the angle of the lower jaw. This proceſs is often, even in adults, not entirely oſſified, but is ligamentous at its root, and ſometimes is compoſed of two or three diſtinct pieces. Round the root of it, eſpecially at the fore-part, there is a remarkable riſing of the os petroſum, which ſome have eſteemed a proceſs; and from the appearance it makes with the ſtyliform have named it vaginal.

Others again have, under the name of auditory proceſs, reckoned among the external proceſſes that ſemicircular ridge, which, running between the root of the maſtoid and zygomatic proceſſes, forms the under part of the external auditory paſſage.

The ſinuoſities or depreſſions on the external ſurface of each of the temporal bones are theſe: a long foſſa at the inner and back part of the root of the mammary proceſs, where the poſterior head of the digaſtric muſcle has its origin. Immediately before the root of the zygomatic proceſs, a conſiderable hollow is left, for lodging the crotaphite muſcle. Between the zygomatic, auditory, and vaginal proceſſes, a large cavity is formed, through the middle of which, from top to bottom, a fiſſure is obſervable, into which part of the ligament that ſecures the articulation of the lower jaw with this bone is fixed. The fore-part of the cavity being lined with the ſame cartilage which covers the tubercle before it, receives the condyle of the jaw; and in the back part a ſmall ſhare of the parotid gland, and a cellular fatty ſubſtance are lodged. At the inſide of the root of the ſtyloid apophyſe there is a thimble-like cavity, where the beginning of the internal jugular vein, or end of the lateral ſinus is lodged; and as the ſinuſſes of the two ſides are frequently of unequal ſize, ſo one of theſe cavities is as often larger than the other. Round the external meatus auditorius ſeveral ſinuoſities are formed for receiving the cartilages and ligaments of the ear, and for their firm adheſion.

The holes that commonly appear on the outſide of each of theſe bones, and are proper to each of them, are five in number. The firſt, ſituated between the zygomatic and maſtoid proceſſes is the orifice of a large funnel-like canal, which leads to the organ of hearing, therefore is called the external auditory paſſage, or aqueduct of Fallopius. The ſecond gives paſſage to the portio dura of the ſeventh pair of nerves; and from its ſituation between the maſtoid and ſtyloid proceſſes, is called foramen ſtylo-maſtoideum. Some way before, and to the inſide of the ſtyloid proceſs, is the third hole, the canal from which runs firſt upwards, then forwards, and receives into it the internal carotid artery, and the beginning of the intercoſtal nerve. Where this canal is about to make the turn forwards, one, or ſometimes two very ſmall holes, go off towards the cavity of the ear, called the tympanum. Through theſe Valſalva affirms, the proper artery, or arteries of that cavity are ſent. On the anterior edge of this bone, near the former, a fourth hole is obſervable, being the orifice of a canal which runs outwards and backwards, in a horizontal direction, till it terminates in the tympanum. This, in the recent ſubject, is continued forward and inward, from the parts which I mentioned juſt now, at its orifice in the ſkeleton, to the ſide of the noſtrils, being partly cartilaginous, and partly ligamentous. The whole canal is named the Euſtachian tube. On the external ſide of the bony part of this canal, and above the chink in the cavity that receives the condyle of the lower jaw, is the courſe of the little nerve, ſaid commonly to be reflected from the lingual branch of the fifth pair, till it enters the tympanum to run acroſs this cavity, and to have the name of chorda tympani. The fifth hole is very uncertain; appearing ſometimes behind the maſtoid proceſs; ſometimes it is common to the temporal and occipital bones; and in ſeveral ſkulls there is no ſuch hole. The uſe of it, when found, is for the tranſmiſſion of a vein from the external integuments to the lateral ſinus: but, in ſome ſubjects, a branch of the occipital artery paſſes through this hole, to ſerve the back part of the dura mater; in others, I have ſeen two or three ſuch holes: but they are oftener wanting than found. And we may in general remark, that the ſize, number, ſituation and exiſtence of all ſuch holes, which for the moſt part allow only a paſſage for veins from without, to the internal receptacles, are very uncertain.

The internal ſurface of the oſſa temporum, is unequal; the upper circular edge of the ſquamous part having numerous ſmall ridges and furrows for its conjunction with the parietal bones; and the reſt of it is irregularly marked with the convolutions of the middle part of the brain, and with furrows made by the branches of the arteries of the dura mater.

From the under part of this internal ſurface, a larger tranſverſe, hard, craggy protuberance, runs horizontally inwards and forwards, with a ſharp edge above, and two flat ſides, one facing obliquely forwards and outwards, and the other as much backwards and inwards. To the ridge between theſe two ſides, the large lateral proceſs of the dura mater is fixed.

Sometimes a ſmall ſeſamoid bone is found between the ſmall end of this petrous proceſs and the ſphenoid bone, as Riolan and Winſlow have remarked. Towards the back part of the os temporum, a large deep foſſa is conſpicuous, where the lateral ſinus lies; and frequently on the top of the petrous ridge, a furrow may be obſerved, where a ſmall ſinus is ſituated.

The internal proper foramina of each of theſe bones are, firſt, the internal meatus auditorius, in the poſterior plain ſide of the petrous proceſs. This hole ſoon divides into two; one of which is the beginning of the aqueduct of Fallopius; the other, according to Valſalva, ends in ſeveral very ſmall canals, that allow a paſſage to the branches of the portio mollis of the ſeventh pair of nerves, into the veſtibule and cochlea. Through it alſo an artery is ſent to be diſtributed to the organ of hearing. The ſecond hole, which is on the anterior plain ſide of the craggy proceſs, as Valſalva alſo teaches, gives paſſage to a reflected branch of the fifth pair of nerves, which joins the hard portion of the auditory nerve while it is in the aqueduct, ſmall branches of blood-veſſels accompanying the nerves, or paſſing through ſmaller holes near this. The paſſage of the cutaneous vein into the lateral ſinus, or of a branch of the occipital artery, is ſeen about the middle of the large foſſa for that ſinus; and the orifice of the canal of the carotid artery is evident at the under part of the point of the petrous proceſs.

Beſides theſe proper holes of the temporal bones which appear on their external and internal ſurfaces, there are two others in each ſide that are common to this bone, and to the occipital and ſphenoidal bones; which ſhall be mentioned hereafter in the deſcription of theſe bones.

The upper round part of the ſquamous bones is thin, but equal; while the low, petrous part, is thick and ſtrong, but irregular and unequal, having the diſtinction of tables and diploe confounded, with ſeveral cavities, proceſſes, and bones within its ſubſtance, which are parts of the organ of hearing. That a clear idea may be had of this beautiful, but intricate organ, anatomiſts generally chuſe to demonſtrate all its parts together. This method is a good one; and therefore, ſince it would be improper to inſert a compleat treatiſe on the ear here, we ſhall omit the deſcription of the parts contained within the os petroſum of the ſkeleton.

The temporal bones are joined above, to the parietal bones by the ſquamous ſutures, and the poſterior additamenta: before, to the ſphenoid bone by the ſuture of that name; to the cheek bones by the zygomatic ſutures; behind, to the occipital bone, by the lambdoid ſuture, and its additions; and are alſo articulated with the lower jaw.

The purpoſes which theſe two bones ſerve, are eaſily collected from the general uſe of the cranium, and from what has been ſaid in the deſcription of their ſeveral parts.

In an infant, a ſmall fiſſure is to be obſerved between the thin upper part, and the lower craggy part of each of theſe bones; which points out the recent union of theſe parts. Neither maſtoid nor ſtyloid proceſſes are yet to be ſeen. Inſtead of a long funnel-like external meatus auditorius, there is only a ſmooth long ring, within which the membrane of the drum is faſtened. At the entry of the Euſtachian tube, the ſide of the tympanum is not compleated. A little more outward than the internal auditory canal, there is a deep pit, over the upper part of whoſe orifice, the anterior ſemi-circular canal of the ear is ſtretched; and ſome way below this, the poſterior ſemicircular canal alſo appears manifeſtly.

The os occipitis, ſo called from its ſituation, is convex on the outſide, and concave internally. Its figure is an irregular ſquare, or rather rhomboid, of which the angle above is generally a little rounded; the two lateral angles are more finiſhed, but obtuſe; and the lower one is ſtretched forward, in form of a wedge, and thence is called by ſome, the cuneiform proceſs.

The external ſurface is convex, except at the cuneiform apophyſe, where it is flattened. At the baſe of this triangular proceſs, on each ſide of the great hole, but more advanced forwards than the middle of it, the large oblong protuberances, named the condyles, appear to ſerve for the articulation of this bone, with the firſt vertebre of the neck. The ſmooth ſurface of each of theſe condyloid proceſſes, is longer from behind forwards, where, by their oblique ſituation, they come much nearer to each other than they are at their back part. Their inner ſides are lower than the external; by which Galen thinks they are prevented from ſliding to either ſide out of the cavities of the firſt vertebre. In ſome ſubjects, each of theſe plain, ſmooth ſurfaces, ſeems to be divided by a ſmall riſing in its middle; and the lower edge of each condyle, next the great foramen, is diſcontinued about the middle by an intervening notch: whence Diemerbroeck and ſome others alledge, that each of theſe apophyſes is made up of two protuberances. Round their root a ſmall depreſſion and roughneſs is obſervable, where the ligaments for ſurrounding and ſecuring their articulations adhere. Though the motion of the head is performed on the condyles, yet the center of gravity of that globe does not fall between them, but is a good way further forward; from which mechaniſm it is evident, that the muſcles which pull the head back, muſt be in a conſtant ſtate of contraction, which is ſtronger than the natural contraction of the proper flexors, elſe the head would always fall forwards, as it does when a man is aſleep, or labours under a palſy, as well as in infants, where the weight of the head far exceeds the proportional ſtrength of theſe muſcles. This ſeeming diſadvantageous ſituation of the condyle, is however of good uſe to us, by allowing ſufficient ſpace for the cavities of the mouth and fauces, and for lodging a ſufficient number of muſcles, which commonly ſerve for other uſes; but may at pleaſure be directed to act on the head, and then have an advantageous lever to act with, ſo as to be able to ſuſtain a conſiderable weight affixed, or any other force applied to pull the head back.

Somewhat more externally than the condyles, there is a ſmall riſing and ſemiluminated hollow in each ſide, which makes part of the holes common to the occipital and petrous bones. Immediately behind this, on each ſide, a ſcabrous ridge is extended from the middle of the condyle, towards the roof of the maſtoid proceſs. Into this ridge the muſculus lateralis Fallopii is inſerted. About the middle of the external convex ſurface, a large arch runs croſs the bone; from the upper lateral parts of which the occipital muſcles have their riſe, to its middle the trapezii are attached; and half way between this and the great hole, a leſſer arch is extended. In the hollows between the middle of theſe arches, the complexi are inſerted; and in the depreſſions more extended, and farther forward than thoſe, the ſplenii are inſerted. Between the middle of the leſſer arch and the great hole, the little hollow marks of the recti minores appear; and on each ſide of theſe, the fleſhy inſertions of the obliqui ſuperiores, and recti majores make depreſſions. Through the middle of the two arches a ſmall ſharp ſpine is placed, which ſerves as a kind of partition between the muſcles of the different ſides, or rather is owing to the muſcles depreſſing the bone on each ſide of it, while this part is quite free from them. Theſe prints of the muſcles on this bone are very ſtrong and plain in ſome ſubjects, but are not ſo diſtinct in others. All round the great foramen the edges are unequal, for the firmer adheſion of the ſtrong circular ligament which goes thence to the firſt vertebre. One end of each lateral or moderator ligament of the head, is fixed to a rough ſurface at the fore-part of each condyle, and the perpendicular one is connected to a rough part of the edge of the great hole between the two condyles. Immediately before the condyles, two little depreſſions are made in the external ſurface at the fore-part of each condyle; and the perpendicular one is connected to a rough part of the edge of the great hole between the two condyles. Immediately before the condyles, two little depreſſions are made in the external ſurface of the cuneiform proceſs, for the inſertion of the recti anteriores minores muſcles, which are unjuſtly aſcribed to Cowper: and ſtill farther forward, near the ſphenoid bone, are two other ſuch depreſſions, for the reception of the recti anteriores majores. When we conſider the ſize of the prints of muſcles on the occipital bone, before and behind its condyles; and, at the ſame time, compare their diſtances from theſe centers of motion of the head, we muſt ſee how much ſtronger the muſcles are which pull the head backwards, than thoſe are which bend it forward; and how much greater force the former acquire by the long lever they act with, than the latter which are inſerted ſo near the condyles. This great force in the extenſor muſcles is altogether neceſſary, that they might not only keep the head from falling forward in an erect poſture, but that they might ſupport it when we bow forward in the moſt neceſſary offices of ſocial life, when the weight of the head comes to act at right angles on the vertebres of the neck, and obtains a long lever to act with.

On the inner ſurface of the occipital bone are two ridges; one ſtanding perpendicular, the other horizontally croſſing the firſt. The upper part of the perpendicular limb of the croſs, to which the falx is fixed, is hollowed in the middle, or often on one ſide, for the reception of the ſuperior longitudinal ſinus; and the lower part of it has the ſmall or third proceſs of the dura mater faſtened to it, and is ſometimes hollowed by the occipital ſinus. Each ſide of the horizontal limb is made hollow by the lateral ſinuſes incloſed in the tranſverſe proceſs of the dura mater, the foſſa in the right-ſide being generally a continuation of the one made by the longitudinal ſinus in the perpendicular limb, and therefore is longer than the left one, as Morgagni obſerves. Round the middle of the croſs there are four large depreſſions ſeparated by its limbs; the two upper ones being formed by the back part of the brain, and the two lower ones by the cerebellum. Farther forward than the laſt mentioned depreſſions is the lower part of the foſſa for the lateral ſinus on each ſide. The inner ſurface of the cuneiform apophyſe is made concave for the reception of the medulla oblongata, and of the baſilar artery. Albinus obſerves, that a furrow is made on each ſide near the edges of this proceſs, by a ſinus of the dura mater, which empties itſelf into the lateral ſinus.

The holes of this bone are commonly five proper, and two common to it, and to the temporal bone. The firſt of the proper holes, called foramen magnum from its ſize, is immediately behind the wedge-like proceſs, and allows a paſſage to the medulla oblongata acceſſory nerves, to the vertebral arteries, and ſometimes to the vertebral veins. At each ſide of this great hole, near its fore-part, and immediately above the condyles, we always find a hole, ſometimes two, which ſoon unite again into one that opens externally; through theſe the ninth pair of nerves go out of the ſkull. The fourth and fifth holes pierce from behind the condyle of each ſide into the foſſa of the lateral ſinuſſes. Often one of theſe holes is wanting, ſometimes both, when the veins paſs through the great foramen. Beſides theſe five, we frequently meet with other holes near the edges of this bone, for the tranſmiſſion of veins, but their number and diameter are very uncertain. The two common foramina are the large irregular holes, one in each ſide, between the ſides of the cuneiform proceſs, and the edges of the petrous bones. In a recent ſubject, a ſtrong membrane runs acroſs from one ſide to the other of each of theſe holes. In ſome heads this membrane is oſſified, or a bony partition divides each hole: and, in the greater number of adult ſkulls, there is a ſmall ſharp pointed proceſs ſtands out from the os petroſum, and a more obtuſe riſing in the occipital bone, between which the partition is ſtretched. Behind this partition, where the largeſt ſpace is left, the lateral ſinus has its paſſage; and before it the eighth pair of nerves and acceſſory nerve make their exit out of the ſkull, and an artery paſſes through this hole, to be ramified on the dura mater.

The occipital bone is one of the thickeſt bones of the ſkull, though unequally ſo; for it is ſtronger above, where it has no other defence than the common integuments, than it is below; where being preſſed by the lobes of the brain and cerebellum on one ſide, and by the action of the muſcles on the other, it is ſo very thin, as to be diaphanous in many ſkulls: but then theſe muſcles ward off injuries; and the ridges and ſpines, which are very frequent here, make it ſufficiently ſtrong to reſiſt ordinary forces. The tables and diploe are tolerably diſtinct in this bone, except where it is ſo thin as to become diaphanous.

The occipital bone is joined above to the oſſa parietalia, and triquetra when preſent, by the lambdoid ſuture; laterally to the temporal bones by the additamenta of the lambdoid ſuture; below to the ſphenoid bone, by the end of its cuneiform proceſs, in the ſame way that epiphyſes and their bones are joined; for in children a ligamentous cartilage is interpoſed between the occipital and ſphenoid bones, which gradually turns thinner, as each of the bones advances, till their fibres at laſt run into each other; and, about ſixteen or eighteen years of age, the union of theſe two bones becomes ſo intimate, that it cannot be ſeparated without violence. The os occipitis is joined by a double articulation to the firſt vertebre of the neck, each condyle being received into a ſuperior oblique proceſs of that vertebre. What motion is allowed here, will be conſidered afterwards, where the vertebres are deſcribed.

The uſes of this bone are apparent from the preceding deſcription.

An infant born at the full time, has this bone divided by unoſſified cartilages into four parts. The firſt of theſe is larger than the other three, is of a triangular ſhape, and conſtitutes all the part of the bone above the great foramen. Generally fiſſures appears in the upper part and ſides of this triangular bone, when all the cartilage is ſeparated by maceration; and ſometimes little diſtinct bones are ſeen towards the edge of it. The ſecond and third pieces of this bone are exactly alike, and ſituated on each ſide of the great foramen; from which, very near the whole condyles are produced; and they are extended forwards almoſt to the fore-part of the hole for the ninth pair of nerves. The fourth piece is the cuneiform proceſs, which forms a ſmall ſhare of the great hole, and of thoſe for the ninth pair of nerves, and of the condyles: betwixt it and the ſphenoid bones, a cartilage is interpoſed.

Of the eight bones which belong to the ſkull, there are only two which are not yet deſcribed, viz. the ethmoid and ſphenoid.

The os ethmoides, or the ſieve-like bone, has its name from the great number of ſmall holes with which that part firſt taken notice of is pierced. When this bone is intire, the figure of it is not eaſily deſcribed; but, by a detail of its ſeveral parts, ſome idea may be afforded of the whole; and therefore I ſhall diſtinguiſh it into the cribriform lamella with its proceſs, the naſal lamella, cellules, and ſpongious bones.

The thin horizontal lamella is all (except its back part) pierced obliquely by a great number of ſmall holes, through which the filaments of the olfactory nerves paſs. In a recent ſubject, theſe holes are ſo cloſely lined by the dura mater, that they are much leſs conſpicuous than in the ſkeleton. From the middle of the internal ſide of this plate, a thick proceſs riſes upwards, and, being higheſt at the fore part, generally becomes lower as it is extended backwards. From ſome reſemblance which this proceſs was imagined to have to a cock's comb, it has been called criſta galli. The falx is connected to its ridge, and to the unperforated part of the cribriform plate. When the criſta is broke, its baſe is ſometimes found to be hollow, with its cavity opening into the noſe. Immediately before the higheſt part of this proceſs, is the blind hole of the frontal bone, which, as was formerly remarked, is often moſtly formed by a notch in the fore-part of the root of the criſta.

From the middle of the outer ſurface of the cribiform lamella, a thin ſolid plate is extended downwards and forwards, having the ſame common baſe with the criſta galli. Generally it is not exactly perpendicular, but inclined to one ſide or other, and therefore divides the cavity of the noſe unequally. Its inclination to one ſide, and flexure in the middle, is ſometimes ſo great, that it fills up a large ſhare of one of the noſtrils, and has been miſtook for a polypus there. It is thin at its riſe, and rather thinner in its middle; yet afterwards, towards its lower edge, it becomes thicker, that its conjunction with the bones and middle cartilage of the noſe might be the more firm.

At a little diſtance from each ſide of this external proceſs, a cellular and ſpongy bony ſubſtance projects downwards from the cribriform plate. The number and figure of the cells in this irregular proceſs of each ſide, are very uncertain, and not to be deſcribed by words; only the cells open into each other, and into the cavity of the noſe; the uppermoſt, which are below the aperture of the frontal ſinuſſes, are formed like funnels. The outer ſurface of theſe cells is ſmooth and plain, where this bone aſſiſts in compoſing the orbit; at which place, on each ſide, it has the name of os planum; on the upper edge of which, a ſmall notch or two may ſometimes be obſerved, which go to the formation of the internal orbitar holes; as has been remarked in the deſcription of the frontal bone.

Below the cells of each ſide, a thin plate is extended inwards, which then bending down, becomes thick, and of a ſpongy texture. This ſpongy part is triangular, with a ſtrait upper edge placed horizontally, an anterior one ſlanting from above, downward and forwards, and with a pendulous convex edge below. The upper and lower edges terminate in a ſharp point behind. The ſide of this pendulous, ſpongy part, next to the ſeptum narium, is convex, and its external ſide is concave. Theſe two proceſſes of the ethmoid bone have obtained the name of the ſpongious, or ſuperior turbinated bones, from their ſubſtance, figure, and ſituation.

All the prominences, cavities, and meanders of the ethmoid bone, are covered with a continuation of the membrane of the noſtrils, in a recent ſubject. Its horizontal cribriform plate is lodged between the orbit proceſſes of the frontal bone, to which it is joined by the ethmoid ſuture, except at the back part, where it is connected with the cuneiform bone, by a ſuture common to both theſe bones, though it is generally eſteemed part of the ſphenoidal. Where the oſſa plana are contiguous to the frontal bone within the orbit, their conjunction is reckoned part of the tranſverſe ſuture. Farther forward than the oſſa plana, the cells are covered by the oſſa unguis, which are not only contiguous to theſe cells, but cannot be ſeparated from them, without breaking the bony ſubſtance; and therefore in juſtice, thoſe bones ought to be demonſtrated as part of the ethmoid bone. Below the oſſa unguis and plana, theſe cells and oſſa ſpongioſa are overlopped by the maxillary bones. The cellular part of each palate-bone is contiguous to each os planum and cells backwards. The lower edge of the naſal perpendicular plate is received into the furrow of the vomer. Its poſterior edge is joined to the fore part of the proceſſus azygos of the ſphenoid bone. Its upper edge joins the naſal proceſs of the frontal and naſal bones, and its anterior one is connected to the middle cartilages of the noſe.

Whence the uſes of this bone are evident, viz. to ſuſtain the anterior lobes of the brain; to give paſſage to the olfactory nerves, and attachment to the falx; to enlarge the organ of ſmelling, by allowing the membrane of the noſe a great extent; to ſtraighten the paſſage of the air through the noſe, by leaving only a narrow winding canal, on the ſenſible membranous ſides of which, the ſubſtances conveyed along with the air muſt ſtrike; to form part of the orbit of the eyes, and the ſeptum narium; while all its parts are ſo light, as not to be in hazard of ſeparating by their weight; and ſo thin, as to form a large ſurface without occupying much ſpace. This brittle ſubſtance, however, is ſufficiently protected from external injuries by firm bones with which it is covered.

If this bone is attacked by any corroding matter, it is eaſily conceived what deſtruction may enſue. Hence it is, that an ozœna is ſo difficult to cure; and that in violent ſcurvies, or in the lues venerea, the fabric of the noſe, eyes, and life itſelf, are in danger. The ſituation of the naſal plate may ſhew us how dangerous a fracture of the bones of the noſe may be, when made by a force applied to their middle fore part, in a perſon in whom this naſal plate is perpendicular.

The ethmoid bone of mature children is divided into two, by a perpendicular cartilage, which, when oſſified, is the criſta galli, and naſal plate: but its other parts are oſſified and complete.

The Os SPHENOIDES, or wedge-like bone, ſo called from its ſituation in the middle of the bones of the ſkull and face, is of a very irregular figure: it however bears ſome faint reſemblance to a bat with its wings extended.

On viewing the external ſurface of the os ſphenoides, two or three remarkable proceſſes from each ſide of it may be obſerved, which are each again ſubdivided. The firſt pair of theſe is the two large lateral proceſſes, or wings; the upper part of each of which is called the temporal proceſs, becauſe they join with the temporal bones in forming the temples, and a place of attachment for ſome part of the crotaphite muſcles. That part of the wings which juts out towards the inſide, ſomewhat lower than the temporal apophyſes, and is ſmooth and hollowed, where it makes up part of the orbit, is thence named the orbitar proceſſes. Behind the edge, ſeparating theſe two proceſſes, there is often a ſmall groove, made by a branch of the ſuperior maxillary nerve, in its paſſage to the temporal muſcle. The loweſt and back part of each wing, which runs out ſharp to the oſſa petroſa, has been ſtiled the ſpinous proceſs: from near the point of which a ſharp-pointed proceſs is frequently produced downwards, which ſome call ſtyliform, that affords origin to the ptery-ſtaphylinus externus muſcle. From this ſtyloid proceſs a very ſmall groove is extended along the edge of the bone to the hollow of the root of the internal plate of the following proceſſes, which forms part of the Euſtachian tube, as Winſlow obſerves. The ſecond pair of external proceſſes of the cuneiform bone, is the two which ſtand out almoſt perpendicular to the baſe of the ſkull: each of them has two plates, and a middle foſſa facing backwards, commonly ſaid to reſemble the wings of a bat, and therefore are named pterygoid, or aliform proceſſes. The external plates are broadeſt, and the internal are longeſt. From each ſide of the external plates the pterygoid muſcles take their riſe. At the root of each internal plate, a ſmall hollow may be remarked, where the ptery-ſtaphylinus internus, or circumflexus palati muſcle has its origin, and ſome ſhare of the cartilaginous end of the Euſtachian tube reſts; and, at the lower end of the ſame plate, is a hook-like riſing or proceſs, round which the tendon of the laſt-named muſcle plays, as on a pulley. From the edge of the external plates ſome ſmall ſharp ſpines project; but their number and ſize are uncertain. To theſe another pair may be added, viz. the little triangular thin proceſs, which comes from each ſide of the body of the ſphenoid bone, where the pterygoid proceſſes are riſing from it, and are extended over the lower part of the aperture of the ſinus, as far as to join the ethmoid bone, while their body hangs down into the noſtrils, as deſcribed by Albinus, and Bertin, in their anatomical plates. Beſides theſe pair of proceſſes, there is a ſharp ridge which ſtands out from the middle of its baſe, becauſe it wants a fellow; it may be called proceſſus azygos. The lower part of this proceſs, where it is received into the vomer, is thick, and often not quite perpendicular, but inclining more to one ſide than the other. The fore part of this proceſs, where it joins to the naſal plate of the os ethmoides, is thin and ſtraight. The two parts have been deſcribed as two diſtinct proceſſes by ſome.

The depreſſions, ſinuoſities, and foſſæ, on the external ſurface of this ſphenoid bone, are very numerous, viz. two on the temporal apophyſes, where the crotaphite muſcles lodge; two on the orbitar proceſſes, for receiving the temporal bones; two between the plates of the pterygoid proceſſes, where the muſculi pterygoidei interni and ptery-ſtaphylini interni are placed; two between the pterygoid and orbitar proceſſus, for forming the holes common to this and to the cheek and maxillary bones; two on the lower ends of the aliform proceſſes, which the palate bones enter into; two at the roots of the temporal and pterygoid proceſſes, where the largeſt ſhare of the external pterygoid muſcles have their riſe; two at the ſides of the proceſſus azygos, for forming part of the noſe, &c.

What has been deſcribed under the name of temporal and ſpinous proceſſes on the outſide of the ſkull, is likewiſe ſeen on its inſide, where they are concave, for receiving part of the brain; and commonly three apophyſes on the internal ſurface of the ſphenoid bone, are only mentioned: two riſing broad from the fore part of its body, become ſmaller as they are extended obliquely backwards. The third ſtanding on a long tranſverſe baſe, near the back part of the body of this bone, riſes nearly erect, and of an equal breadth, terminating often in a little knob on each ſide. The three are called clinoid, from ſome reſemblance they were ſuppoſed to have to the ſupporters of a bed. Sometimes one or both the anterior clinoid proceſſes are joined to the ſides of the poſterior one, or the body of the bone itſelf. From the roots of the anterior clinoid proceſſes, the bone is extended on each ſide outwards and forwards, till it ends in a ſharp point, which may have the name of the tranſverſe ſpinous proceſſes. Between, but a little farther back than the two anterior clinoid proceſſes, we ſee a protuberance conſiderably ſmaller than the poſterior clinoid proceſs, but of its ſhape. Another proceſs from between the tranſverſe proceſſes, often forces itſelf forwards into the ethmoid bone.

Within the ſkull there are two ſinuoſities in the internal part of each wing of the ſphenoid bone, for receiving the middle part of the brain. One between the tranſverſe ſpinous proceſſes, for lodging the part of the brain where the crura medullæ oblongatæ are. Immediately before the third or middle clinoid proceſs, a ſingle pit generally may be remarked, from which a foſſa goes out on each ſide to the holes through which the optic nerves paſs. The pit is formed by the conjoined optic nerves; and in the foſſæ theſe nerves are lodged, as they run divided within the ſkull. Between that third protuberance and the poſterior clinoid proceſs, the larger pit for the glandula pituitaria may be remarked. This cavity, becauſe of its reſemblance to a Turkiſh ſaddle, is always deſcribed under the name of ſella turcica, or ephippium. On the ſides of the poſterior clinoid proceſs, a foſſa may be remarked, that ſtretches upwards, then is continued forwards along the ſides of the ſella turcica near to the anterior clinoid proceſſes, where a pit on each ſide is made. Theſe foſſa point out the courſe of the two internal carotid arteries, after they have entered the ſkull. Beſides all theſe, ſeveral other foſſæ may be obſerved, leading to the ſeveral holes, and imprinted by the nerves and blood veſſels.

The holes on each ſide of the ſphenoid bone are ſix proper, and three common. The firſt is the round one immediately below the anterior clinoid proceſſes, for the paſſage of the optic nerve, and of the branch of the internal carotid artery that is ſent to the eye. The ſecond is the foramen lacerum, or large ſlit between the tranſverſe, ſpinous, and orbitar proceſſes: the interior end of which ſlit is large, and, as it is extended outwards, it becomes narrower. The outer end of it is formed in the os frontis; and therefore this might be reckoned among the common foramina. Through it the third, fourth, the firſt branch of the fifth, and the greater ſhare of the ſixth pair of nerves, and an artery from the internal carotid, go into the orbit. Sometimes, as Winſlow remarks, a ſmall branch of the external carotid enters near its end, to be diſtributed to the dura mater; and a vein, ſome call it the venous duct, or Nuck's aqueduct, returns through it to the cavernous ſinus. The third hole, ſituated a little below the one juſt now deſcribed, is called rotundum, from its ſhape. It allows a paſſage to the ſecond branch of the fifth pair of nerves, or ſuperior maxillary nerve, into the bottom of the orbit. The fourth is the foramen ovale, about half an inch behind the round hole. Through it the branch of the fifth pair, or inferior maxillary nerve, goes out; and ſometimes, as Ingraſſias ſays, a vein from the dura mater paſſes out here. Very near the point of the ſpinous proceſs is the fifth hole of this bone: it is ſmall and round, for a paſſage to the largeſt artery of the dura mater, which often is accompanied with a vein. The ſixth proper hole, Veſalius, Euſtachius, and others obſerve, cannot be well ſeen, till the cuneiform bone is ſeparated from all the other bones of the ſkull; for one end of it is hid by a ſmall protuberance of the internal plate of the pterygoid proceſs, and by the points of the petrous proceſs of the temporal bone. Its canal is extended above the inner plate of the pterygoid proceſs; and where it opens into the cavity of the noſe, it is concealed by the thin laminous part of the palate bone. Through it a conſiderable branch of the ſecond branch of the fifth pair of nerves is reflected. Often in the middle of the ſella turcica, a ſmall hole or two pierce as far as the cellular ſubſtance of the bone; and ſometimes at the ſide of this ſella one or more ſmall holes penetrate into the ſphenoidal ſinuſſes. Theſe obſervations afforded Sylvius Laurentius and others, an argument of weight in their time, in defence of Galen, who aſſerts the deſcent of the pituita that way into the ſinuſſes below.

The firſt of the common holes is that unequal fiſſure at the ſide of the ſella turcica, between the extreme point of the os petroſum, and the ſpinous proceſs of the cuneiform bone. This hole only appears after the bones are cleaned; for in a recent ſubject, its back part is covered by a thin bony plate that lies over the internal carotid artery, and further forward it is filled with a cartilaginous ligament, under which the cartilaginous part of the Euſtachian tube is placed: it was by this paſſage that the ancients believed the ſlimy matter was conveyed from the emunctory of the brain, the glandula pituitaria, to the fauces. The ſecond common hole is the large diſcontinuation of the external ſide of the orbit, left between the orbitar proceſſes of the cuneiform, maxillary cheek bones, and the os palati. In this large hole the fat for lubricating the lobe of the eye and the temporal muſcle is lodged, and branches of the ſuperior maxillary nerve, with ſmall arteries from the carotid and veins paſs. The third hole is formed between the baſe of this bone, and the root of the orbitar proceſs of the palate bone of each ſide. Through this a branch of the external carotid artery, and of the ſecond branch of the fifth pair of nerves, are allowed a paſſage to the noſtrils, and a returning vein accompanies them. Sometimes, however, this hole is proper to the palate bone, being intirely formed out of its ſubſtance.

Under the ſella turcica, and ſome way farther forward, but within the ſubſtance of the ſphenoid bone, are two ſinuſſes, ſeparated by a bony plate. Each of them is lined by a membrane, and opens into the upper and back part of each noſtril by a round hole, which is at their upper fore part. This hole is not formed only by the os ſphenoides, which has an aperture near as large as any tranſverſe ſection of the ſinus, but alſo by the palate bones which are applied to the fore part of theſe ſinuſſes, and cloſe them up, that hole only excepted, which has been already mentioned. Frequently the two ſinuſſes are of unequal dimenſions, and ſometimes there is only one large cavity, with an opening into one noſtril. Albinus aſſerts, theſe cavities are extended ſometimes as far back as the great foramen of the occipital bone. In other ſubjects they are not to be found, when the bone is compoſed of large cells: Veſalius mentions a cavity within the partition of the ſinuſſes; but it is ſmall. The ſphenoid ſinuſſes ſerve for the ſame uſes as the frontal do.

As this bone is extremely ragged and unequal, ſo its ſubſtance is of a very different thickneſs, being in ſome places diaphanous; in others it is of a middle thickneſs, and its middle back part ſurpaſſes the greateſt ſhare of the ſkull in thickneſs.

The os ſphenoides is joined, by its wings, to the parietal bones above, to the os frontis and oſſa malarum before, to the temporal bones behind; by the fore part of its body and ſpinous proceſſes, to the frontal and ethmoid bones; by its back part, behind the two ſinuſſes, to the occipital, where it looks like a bone with the epiphyſes taken off, and, as was formerly obſerved in the deſcription of the occipital bone, it cannot be ſeparated without violence in adults; to the palate bones, by the ends of the pterygoid proceſſes, and ſtill more by the fore part of the internal plates of the pterygoid proceſſes, and of the ſinuſſes; to the maxillary bones, by the fore part of the external pterygoid plates; to the vomer and naſal plate of the os ethmoides, by the proceſſus azygos. All theſe conjunctions, except the laſt, which is a ſchindyleſis, are ſaid to be, by the ſuture, proper to this bone; though it is at firſt evident, that ſeveral other ſutures, as the tranſverſe, ethmoidal, &c. are confounded with it.

We now ſee how this bone is joined to all the bones of the ſkull, and to moſt of the upper jaw; and therefore obtained the name of the wedge-like bone.

The uſes are ſo blended with the deſcription, as to leave nothing new to be added concerning them.

The ſphenoidal bone is almoſt complete in a fœtus of nine months; only the great alæ ſeparate after maceration from the body of the bone. The proceſſus azygos is very large and hollow; the thin triangular proceſſes are not oſſified; the internal ſurface of the body is unequal and porous; the ſinuſſes do not appear.

Whoever is acquainted with each bone of the ſkull, can, without difficulty, examine them as they ſtand united, ſo as to know the ſhapes, ſizes, diſtances, &c. of their ſeveral parts, and the forms, capacities, &c. of the cavities formed by them, which is of great uſe towards underſtanding the anatomy of the parts contiguous to, contained within, or connected to them. Such a review is neceſſary, after conſidering each claſs of bones. Thus the orbits, noſtrils, mouth, face, head, ſpine, thorax, pelvis, trunk, extremities, and ſkeleton, ought likewiſe to be examined.

The face is the irregular pile of bones, compoſing the fore and under part of the head, which is divided, by authors, into the upper and lower maxillæ, or jaws.

The ſuperior maxilla is the common deſignation given to the upper immoveable part of the face; though, if we would follow Celſus, we ſhould apply the word maxilla to the lower jaw only, and the name mala to this upper jaw. In compliance to prevailing cuſtom, we ſhall, however, uſe the terms as now commonly employed. The ſhape of the ſuperior jaw cannot eaſily be expreſſed; nor is it neceſſary, provided the ſhape and ſituation of the bones which compoſe it are deſcribed. It is bounded above by the tranſverſe ſuture, behind by the fore part of the ſphenoid bone, and below by the mouth.

The upper jaw conſiſts of ſix bones on each ſide, of a thirteenth bone which has no fellow, placed in the middle, and of ſixteen teeth. The thirteen bones are, two oſſa naſi, two oſſa unguis, two oſſa malarum, two oſſa maxillaria, two oſſa palati, two oſſa ſpongioſa inferiora, and the vomer.

The oſſa naſi are placed at the upper part of the noſe; the oſſa unguis are at the internal canthi of the orbits; the oſſa malarum form the prominence of the cheeks; the oſſa maxillaria form the ſide of the noſe, with the whole lower and fore part of the upper jaw, and the greateſt ſhare of the roof of the mouth; the oſſa palati are ſituated at the back part of the palate, noſtrils, and orbit; the oſſa ſpongioſa are ſeen in the lower part of the nares; and the vomer helps to ſeparate theſe two cavities.

The bones of the upper jaw are joined to the bones of the ſkull by the ſchindyleſis and ſutures already deſcribed as common to the ſkull and face, and are connected to each other by gomphoſis and fifteen ſutures.

The gomphoſis only is where the teeth are fixed in their ſockets; and the ſchindyleſis is only where the edges of the vomer are joined to other bones.

The ſutures are generally diſtinguiſhed by numbers, which have been differently applied; and therefore we coincide in opinion with Vander Linden, Rolfinc, and Schenkius, who prefer giving names to each, which may be eaſily contrived from their ſituation, or from the bones which they connect.

The firſt is the anterior naſal, which is ſtraight, and placed longitudinally in the middle fore-part of the noſe.

The ſecond and third are the lateral naſal, which are at each ſide of the noſe, and almoſt parallel to the firſt ſuture.

Each of the two lacrymal is almoſt ſemicircular, and is placed round the lacrymal groove.

The ſixth and ſeventh are the internal orbitar; each of which is extended obliquely from the middle of the lower ſide of an orbit to the edge of its baſe.

The two external orbitars are continued, each from the end of the internal orbitar, to the under and fore part of the cheek.

The tenth is the myſtachial, which reaches only from the lower part of the ſeptum narium to between the two middle dentes inciſores.

The longitudinal palate ſuture ſtretches from the middle of the foremoſt teeth through the middle of all the palate.

The tranſverſe one runs acroſs the palate, nearer the back than the fore part of it.

Each of the two palato-maxillary is at the back part of the ſide of each noſtril.

The next is the ſpinous, which is in the middle of the lower part of the noſtrils. This may perhaps be rather thought a double ſchindyleſis.

The connection of the oſſa ſpongioſa to the ſide of each noſtril, is ſo much by a membrane in young ſubjects, by a ſort of hook, and afterwards by concretion or union of ſubſtance in adults, that I did not know well how to rank it: but if any chuſe to call it a ſuture, the addition of two tranſverſe naſal ſutures may be made to thoſe above named.

Theſe ſutures of the face (formerly called harmoniæ) have not ſuch conſpicuous indentations as thoſe of the ſkull have; the bones here not having ſubſtance enough for forming large indentations, and there being leſs neceſſity for ſecurity againſt external injuries, or any internal protruding force than in the cranium. Theſe ſutures often diſappear in old people, by the bones running into each other; which can do little prejudice, becauſe the principal uſe of the bones being ſo numerous here, is to allow them to be extended into a proper form.

It is evident, from the manner of the conjunction of theſe bones, that they can have no motion, except in common with the ſkull.

The purpoſes which this pile of bones ſerves, will be ſhewn in the deſcription which will be given of each of them.

Oſſa naſi, ſo named from their ſituation at the root of the noſe, are each of an irregular oblong ſquare figure, being broadeſt at their lower end, narroweſt a little higher than their middle, and becoming ſomewhat larger at the top, where they are ragged and thickeſt, and have a curvature forwards, that their connexion with the frontal bone might be ſtronger. Theſe bones are convex externally, and thereby better reſiſt any violence from without; and they are concave internally, for enlarging the cavity of the noſe.

The lower edge of theſe bones is unequal, and is ſtretched outwards and backwards, to join the cartilages of the noſtrils. Their anterior ſide is thick, eſpecially above, and unequal, that their conjunction to each other might be ſtronger; and a ſmall riſing may be remarked on their inner edge, where they are ſuſtained by the ſeptum narium. Their poſterior ſide, at its upper half, has externally a depreſſion, where it is over-lapped ſome way by the maxillary bones: by which contrivance, they do not yield eaſily to preſſure applied to their fore-part or ſides.

A ſmall hole is frequently to be obſerved on their external ſurface, into which two, three, or four holes, which appear internally, terminate, for the tranſmiſſion of ſmall veins; ſometimes the holes go no further than the cancelli of the bones.

The naſal bones are firm and ſolid, with very little cells or cancelli in them; the thin ſubſtance of which they conſiſt not requiring much marrow.

They are joined above to the frontal bone, by the middle of the tranſverſe ſuture; behind, to the maxillary bones, by the lateral naſal ſutures; below, to the cartilages of the noſe; before, to one another, by the anterior naſal ſuture; internally, to the ſeptum narium.

Theſe bones ſerve to cover and defend the root of the noſe.

In an infant the naſal bones are proportionally ſhorter, and leſs thick at their upper part than in an adult, but are otherwiſe compleat.

Oſſa unguis, or lachrimalia, are ſo named, becauſe their figure and magnitude are ſomething near to thoſe of a nail of one's finger, and becauſe the tears paſs upon them into the noſe.

Their external ſurface is compoſed of two ſmooth concavities and a middle ridge. The depreſſion behind forms a ſmall ſhare of the orbit for the eye-ball to move on, and the one before is a deep perpendicular canal, or foſſa, larger above than below, containing part of

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the lachrimal ſac and duct. This is the part that ought to be pierced in the operation for the fiſtula lachrymalis. This foſſa of the bone is cribriform, or has a great number of ſmall holes through it, that the filaments from the membrane which lines it, inſinuating themſelves into theſe holes, might prevent a ſeparation of the membrane, and ſecure the bone in its natural ſituation. The ridge between theſe two cavities of the os unguis, is the proper boundary of the orbit at its internal canthus; and beyond which ſurgeons ſhould not proceed backwards in performing operations here. The internal or poſterior ſurface of this bone conſiſts of a furrow in the middle of two convexities.

The ſubſtance of the os unguis is as thin as paper, and very brittle; which is the reaſon that thoſe bones are often wanting in ſkeletons, and need little force to pierce them in living ſubjects.

Each of theſe bones is joined; above, to the frontal bone, by part of the tranſverſe ſuture; behind, to the os planum of the ethmoid bone, by the ſame ſuture; before and below, to the maxillary bone, by the lachrymal ſuture. Internally, the oſſa unguis cover ſome of the ethmoidal ſinuſſes; nay, are nearly continuous with the bony lamella which make up the ſides of theſe cells; ſo that they are as much part of the ethmoid bone as the oſſa plana.

Theſe unguiform bones compoſe the anterior internal parts of the orbits, lodge a ſhare of the lachrymal ſac and duct, and cover the ethmoid cells. Their ſituation and tender ſubſtance make a raſh operator in danger of deſtroying a conſiderable ſhare of the organ of ſmelling, when he is performing the operation of the fiſtula lachrymalis: but when theſe bones are hurt, they caſt off without much difficulty, and conſequently the wound is ſoon cured, unleſs the patient labours under a general cacoethes, or there is a pre-diſpoſition in the bones to caries; in which caſe, a train of bad ſymptoms follow, or, at beſt, the cure proves tedious.

Theſe bones are fully formed in a new-born child.

Oſſa malarum was the name given by Celſus to all the upper jaw; but is now appropriated to the prominent ſquare bones which form the cheek on each ſide. Before their ſurface is convex and ſmooth, backward it is unequal and concave, for lodging part of the crotaphyte muſcles.

The four angles of each of theſe bones have been reckoned proceſſes by ſome. The one at the external canthus of the orbit, called the ſuperior orbitar proceſs, is the longeſt and thickeſt. The ſecond terminates near the middle of the lower edge of the orbit in a ſharp point, and is named the inferior orbitar proceſs. The third, placed near the lower part of the cheek, and thence called maxillary, is the ſhorteſt, and neareſt to a right angle. The fourth, which is called zygomatic, becauſe it is extended backwards to the zygoma of the temporal bone, ends in a point, and has one ſide ſtraight, and the other ſloping. Between the two orbitar angles there is a concave arch, which makes about a third of the external circumference of the orbit, from which a fifth proceſs is extended backwards within the orbit,

bit, to form near one third of that cavity; and hence it may be called the internal orbitar proceſs. From the lower edge of each of the oſſa malarum, which is between the maxillary and zygomatic proceſſes, the maſſeter muſcle takes its origin; and from the exterior part of the zygomatic proceſs, the muſculus diſtortor oris riſes; in both which places the ſurface of the bone is rough.

On the external ſurface of each cheek bone, one or more ſmall holes are commonly found for the tranſmiſſion of ſmall nerves or blood-veſſels from, and ſometimes into the orbit. On the internal ſurface are the holes for the paſſage of the nutritious veſſels of theſe bones. A notch on the outſide of the internal orbitar proceſs of each of theſe bones, aſſiſts to form the great ſlit common to this bone, and to the ſphenoid, maxillary, and palate bones.

The ſubſtance of theſe bones is in proportion to their bulk, thick, hard, and ſolid, with ſome cancelli.

Each of the oſſa malarum are joined by their ſuperior and internal orbitar proceſſes, to the os frontis, and to the orbitar proceſs of the ſphenoid bone by the tranſverſe ſuture. By the edge between the internal and inferior orbitar proceſſes, to the maxillary bone by the internal orbitar ſuture. By the ſide between the maxillary and inferior orbitar proceſs, again to the maxillary bone by the external orbitar ſuture. By the zygomatic proceſs to the os temporum, by the zygomatic ſuture.

The cheek bones are entire, and fully oſſified in all their parts in children.

The oſſa maxillaria ſuperiora, are the largeſt bones, and conſtitute the far greater part of the upper jaw, which has appropriated the name of maxillaria to them. The figure of one of them, or of the two when joined, is ſo irregular, that words can ſcarce give an idea of it.

The proceſſes of each maxillary bone may be reckoned ſeven. The firſt is the long naſal one at its upper and fore part, which is broad below, and turns ſmaller as it riſes upwards, to make the ſide of the noſe. At the root of this, a tranſverſe ridge may be obſerved within the noſtrils, which ſupports the fore part of the upper edge of the inferior ſpongious bone. The ſecond is produced backwards and outwards, from the root of the naſal proceſs, to form the lower ſide of the orbit; and therefore may be called the orbitar: the edge of this orbitar proceſs, and the ridge of the naſal one which is continued from it, make a conſiderable portion of the external circumference of the orbit. From the proper orbitar proceſs, a very rough, triangular ſurface is extended downwards and outwards, to be connected to the cheek bone; and therefore may be called the malar proceſs; from the loweſt protuberant part of which, ſome ſhare of the maſſeter muſcle takes its riſe. Behind the orbitar proceſs, a large tuberoſity or bulge of the bone appears, which is eſteemed the fourth proceſs. On the internal part of this, we often meet with a ridge almoſt of the ſame height with that in the naſal proceſs, which runs tranſverſely, and is covered by a ſimilar ridge of the palate bone on which the back part of the upper edge of the os ſpongioſum inferius reſts. The convex back part of this tuberoſity is rough, for the origin of part of the external pterygoid muſcle, as Albinus has remarked; and more internally is ſcabrous, where the palate and ſphenoid bones are joined to it. That ſpongy protuberance at the lower circumference of this bone, where the ſockets for the teeth are formed, is reckoned the fifth. The ſixth is the horizontal plate which forms the greater part of the baſe of the noſtrils and roof of the mouth: its upper ſurface, which belongs to the noſtrils, is very ſmooth; but the other below is arched and rough, for the ſtronger adheſion of the membrane of the mouth, which is ſtretched upon it; and in chewing, ſpeaking, &c. might otherwiſe be liable to be ſeparated. The ſeventh riſes like a ſpine from the inner edge of the laſt, and forms a ſmall part of the partition of the noſtrils.

The depreſſions in each maxillary bone are, 1ſt. A ſinuoſity behind the orbitar proceſs made by the temporal muſcle. 2dly, A pit immediately before the ſame proceſs, where the origins of the muſculus elevator labiorum communis, and elevator labii ſuperioris, with a branch of the fifth pair of nerves, are lodged ſecurely. 3dly, The hollow arch of the palate. 4thly, The ſemicircular great notch, or entry to the lower part of the noſtrils, betwixt the root of the naſal proceſs and ſpine of the palate plate. Below this, the fore part of the bone is flatted, or ſometimes hollowed by the muſculus depreſſor labii ſuperioris. 5thly, The ſockets for the teeth; the number of theſe ſockets is uncertain; for the ſame number of teeth is not in all people, and the four backmoſt teeth of each ſide of each jaw vary greatly in their number of roots; and when the teeth of a living perſon fall out, or are taken away, the ſockets fill up with an oſſeous net-work, which becomes ſolid afterwards. 6thly, The lachrymal foſſa in the naſal proceſs, which aſſiſts the os unguis to form a paſſage for the lachrymal duct. This part of the bone forming this foſſa is ſo firm and ſtrong, that a ſurgeon ſcarce can perforate it with the ordinary inſtruments for the fiſtula lachrymalis, and therefore ought to avoid it in doing this operation. Immediately on the outſide of this there is a ſmall depreſſion from which, Winſlow ſays, the inferior or leſſer oblique muſcle of the eye has its origin. 7thly, The canal on the upper part of the great tuberoſity within the orbit, which is almoſt a compleat hole: in this, a branch of the ſuperior maxillary nerves paſſes. Beſides theſe, the ſuperior ſurface of the great bulge is concave, to receive the under part of the eye. Immediately above the tranſverſe ridge in the naſal proceſs, a ſmall hollow is formed by the os ſpongioſum. In ſome ſubjects, the naſal proceſs has a ſmall round pit above the lachrymal duct, where the little tendon or ligament of the orbicular muſcle of the eye-lids is inſerted. It is this tendon, and not the tendon of the larger oblique muſcle of the eye, which there is ſome hazard of cutting in the operation of the fiſtula lachrymalis.

The holes of this bone are two proper, and two common, which are always to be found, beſides ſeveral others, whoſe magnitude, number, &c. are uncertain. The firſt of the proper is the external orbitar immediately below the orbit, by which the infra-orbitar branch of the ſecond branch of the fifth pair of nerves, and a ſmall artery, come out, after having paſſed in the canal, at the bottom of the orbit as deſcribed in No. 7. of the depreſſions. This hole is often double, and that when the nerves has happened to ſplit before it has eſcaped from the bone. The ſecond is the foramen inciſivum, juſt behind the fore teeth, which, at its under part, is one irregular hole common to both the maxillary bones when they are joined; but as it aſcends, ſoon divides into two, three, or ſometimes more holes; ſome of which open into each noſtril. Through them ſmall arteries and veins, and a twig of the ſecond branch of the fifth pair of nerves paſs, and make a communication between, or join the lining coats of the noſe and mouth. In ſome ſubjects, Steno's duct may be traced ſome way on the ſide of theſe paſſages next to the noſe, and ſmall orifices may be obſerved opening into the mouth.

The firſt common hole is that which appears at the inner ſide of the back part of the tuberoſity, and of the ſockets of the teeth, and is formed by a foſſa in this bone, and a correſponding one in the os palati: through it a nerve, which is a branch of the ſecond branch of the fifth pair, runs to the palate. The other common hole is the great ſlit in the outſide of the orbit deſcribed already, as the ſecond common hole of the ſphenoid bone.

On the naſal proceſs, according to Highmore, holes may often be obſerved for the paſſage of veſſels to the ſubſtance of the bones, and at the back part of each tuberoſity, ſeveral foramina are placed, for the tranſmiſſion of nerves to the cavity within, but theſe are uncertain.

All the body of the maxillary bone is hollow, and leaves a large ſinus a-kin to the frontal and ſphenoid, which is commonly, but unjuſtly called, Antrum Highmorianum. When the os maxillare is ſingle, or ſeparated from all the other bones of a ſkeleton, its antrum appears to have a large aperture into the noſtrils, but, in a recent ſubject, it is ſo covered at its backward part by the palate bone; in the middle by the os ſpongioſum inferius before by a ſtrong membrane; that one, or ſometimes two holes, ſcarce larger than a crow quill, are only left at the upper part, which, after a ſhort winding progreſs, open into the noſtrils between the two oſſa ſpongioſa. At the bottom of this cavity, we may often obſerve ſome protuberances, in which the ſmall points of the roots of the teeth are contained. This cavity, and the ſockets of the teeth, are often divided by the interpoſition of a very thin bony plate, which is liable to be eroded by acrid matter collected in the antrum, or to be broke in drawing a tooth, as Highmore has remarked. The ſymptoms of a collection of a matter here, naturally lead us to the practice of pulling out the teeth, and piercing through this plate into the antrum, to procure an evacuation of the collected matter; by which, Cowper takes notice, conſiderable ſervice is frequently done.

The maxillary ſinuſſes have the ſame uſes as the frontal and ſphenoidal; and the ſituation of the ſinuſſes is ſuch, that the liquor drilling into them from the cells of the ethmoid and palate bones, and from the lachrymal ducts, may always moiſten all the parts of the membrane of the noſe in the different ſituations which the head is in.

Though the membranes which line the frontal, ſphenoidal, and maxillary ſinuſſes are continuations of the one which covers the bones within the noſe, yet they are much thinner than that is, and have ſo much ſmaller veſſels, that the injection which makes the membrane of the noſe red all over, fills only ſome few veſſels of the maxillary ſinuſſes, and ſcarce is obſerved in the frontal and ſphenoidal. Are not the larger veſſels intended for a more plentiful ſecretion of a viſcid liquor to defend the membrane from the effects of the perflatus, which is conſtantly through the noſe? Are not the membranes which have the ſmalleſt veſſels, ceteris paribus, the moſt ſenſible? Do not many phænomena of ſmelling, inflammations of theſe parts, megrim, polypi, &c. depend on this ſtructure of theſe membranes?

The ſubſtance of the maxillary bones is compact and firm, except at the inferior proceſſes, in which the teeth are lodged, where it is very ſpongy.

The maxillary bones are joined above by the upper ends of the naſal proceſſes to the os frontis by the tranſverſe ſuture: at the ſides of theſe proceſſes, to the oſſa unguis, by the lachrymal ſutures; to the naſal bones, by the lateral naſal ſutures; by their orbitar proceſſes, to the cheek bones, by the external orbitar ſutures; by the internal ſides of the internal orbitar proceſſes, to the oſſa plana, by part of the ethmoidal ſuture; by the back part of the tuberoſities, to the palate bones, by the ſutures called palato-maxillares; by the poſterior edges of their palatine lamellæ, to the oſſa palati, by the tranſverſe palate ſuture; by their naſal ſpines, to the vomer, by the ſpinous ſuture; by their ſockets to the teeth, by gomphoſis; by the internal edge of the palate plate, to one another, by the longitudinal palate ſuture: on the upper and fore part of which, a furrow is left for receiving the cartilage which forms the partition of the noſtrils; between the fore-part of the noſtrils and mouth, to each other, by the myſtachial ſuture: ſometimes they are connected to the oſſa ſpongioſa inferiora, by a plain concretion or union of ſubſtance.

Theſe bones form the greater part of the noſe, and of the roof of the mouth, and a conſiderable ſhare of the orbit. They contain ſixteen teeth, give riſe to muſcles, tranſmiſſion to nerves, &c. as mentioned in the deſcription of their ſeveral parts.

In each of the maxillary bones of a new-born child, the external orbitar proceſs is hollow, with remarkable holes in it. There are five ſockets for the teeth, of which the two poſterior are very large, and, according to Albinus, when divided by a ſecond croſs partition, make the number of ſockets ſix. The palate plate is cribriform about the middle. The great tuberoſity is not formed: inſtead of the antrum, there is only an oblong depreſſion at the ſide of the noſtrils.

The bones of the palate are commonly deſcribed, particularly by Euſtachius, Vidus Vidius, and Winſlow, as two ſmall ſquare bones at the back part of the palate or roof of the mouth, though they are of much greater extent, being continued up the back part of the noſtrils to the orbit. Each palate bone may therefore be divided into four parts: the palate ſquare bone, the pterygoid proceſs, naſal lamella, and orbitar proceſs.

The ſquare bone is unequally concave, for enlarging both the mouth and cavity of the noſe. The upper part of its internal edge riſes in a ſpine, after the ſame manner as the palate plate of the maxillary bone does, to be joined with the vomer. Its anterior edge is unequally ragged, for its firmer connexion with the palate proceſs of the os maxillare. The internal edge is thicker than the reſt, and of an equal ſurface, for its conjunction with its fellow on the other ſide. Behind, this bone is ſomewhat in form of a creſcent, and thick, for the firm connexion of the velum pendulum palati; the internal point being produced backwards, to afford origin to the palato ſtaphylinus, or azygos muſcle. This ſquare bone is well diſtinguiſhed from the pterygoid proceſs, by a perpendicular foſſa, which applied to ſuch another in the maxillary bone, forms a paſſage for the palatine branch of the fifth pair of nerves; and by another ſmall hole behind this, through which a twig of the ſame nerve paſſes.

The pterygoid proceſs is ſomewhat triangular, having a broad baſe, and ending ſmaller above. The back part of this proceſs has three foſſa formed in it; the two lateral receive the ends of the two plates of the ſphenoid bone, that are commonly compared to a bat's wings; the middle foſſa makes up a part of what is commonly called the foſſa pterygoidea: the fore-ſide of this palatine pterygoid proceſs is an irregular concave, where it receives the back part of the great tuberoſity of the maxillary bone. Frequently, ſeveral ſmall holes may be obſerved in this triangular proceſs, particularly one near the middle of its baſe, which a little above communicates with the common and proper holes of this bone already taken notice of.

The naſal lamella of this bone is extremely thin and brittle, and riſes upwards from the upper ſide of the external edge of the ſquare bone, and from the narrow extremity of the pterygoid proceſs; where it is ſo weak, and, at the ſame time, ſo firmly fixed to the maxillary bone, as to be very liable to be broken in ſeparating the bones. From the part where the plate riſes, it runs up broad on the inſide of the tuberoſity of the maxillary bone, to form a conſiderable ſhare of the ſides of the maxillary ſinus, and to cloſe up the ſpace between the ſphenoid, and the great bulge of the maxillary bone, where there would otherwiſe be a large ſlit opening into the noſtrils, as Albinus obſerves. From the middle internal ſide of this thin plate, a croſs ridge, placed on ſuch another of the maxillary bone, is extended; on it, the back part of the os ſpongioſum inferius reſts. Along the outſide of this plate, the perpendicular foſſa, made by the palate nerve, is obſervable.

At the upper part of this naſal plate, the palate bone divides into two proceſſes, which have been already named orbitar; between which, and the body of the ſphenoid bone, that hole is formed, which was mentioned as the laſt of the holes common to the ſphenoid bone. Sometimes this hole is wholly formed in the os palati, by a croſs plate going from the one orbitar proceſs to the other. A nerve, artery, and vein, belonging to the noſtrils, paſs here. The anterior of the two orbitar proceſſes is the largeſt, and has its fore part contiguous to the back part of the maxillary ſinus; and its upper ſurface appears in the bottom of the orbit, behind the back part of the os maxillare and planum: it has cells behind, reſembling thoſe of the ethmoid bone, to which it is contiguous: it is placed on the aperture of the ſinus ſphenoidalis, ſo as to leave only a round hole at its upper fore part. The other part of the orbitar proceſs is extended along the internal ſide of the upper back part of the maxillary tuberoſity, to the baſe of the ſphenoid bone, between the root of the proceſſus azygos and the pterygoid proceſs.

The palate ſquare part of this palate bone, and its pterygoid proceſs, are firm and ſtrong, with ſome cancelli; but the naſal plate and orbitar proceſſes are very thin and brittle.

The palate bones are joined to the maxillary, by the fore edge of the palate ſquare bone, by the tranſverſe palate ſuture; by their thin naſal plates, and part of their orbitar proceſſes, to the ſame bones, by the palato maxillares ſutures; by their pterygoid proceſſes and back part of the naſal plates, to the alæ veſpertilionum, by the ſphenoid ſuture; by the tranſverſe ridges of the naſal plates, to the oſſa ſpongioſa inferiora, by contact: hence frequently there is an intimate union of the ſubſtance of theſe bones in old ſkulls; by the orbitar proceſſes, to the oſſa plana and ethmoid cellules, by the ethmoid ſuture; to the body of the ſphenoid bone, by the ſphenoid ſuture; by the internal edge of the ſquare bones, to each other, by the longitudinal palate ſuture; and by their naſal ſpines, to the vomer, by the ſpinous ſuture.

The palate-bones form part of the palate, noſtrils, orbits, and foſſæ pterygoideæ; and they cover part of the ſinus maxillares, ſphenoidales, and ethmoidei.

Theſe bones are very compleat in a new-born infant, the naſal plates being then thicker and ſtronger than in adults; but the orbitar proceſſes have not the cells which appear in the bones of adults.

When we are acquainted with the hiſtory of theſe bones, the reaſon is evident, why the eyes are ſo much affected in ulcers of the palate, as to be often attended with blindneſs, which frequently happens in an ill-managed lues venerea; or why, on the other hand, the palate ſuffers from an ægylops.

Oſſa turbinata, or ſpongioſa inferiora, reſemble the ſuperior oſſa ſpongioſa in ſhape and ſubſtance, but have their anterior and upper edges contiguous to the tranſverſe ridges of the naſal proceſſes of the maxillary and palate bones. From their upper ſtreight edge, two ſmall proceſſes ſtand out; the poſterior of which is broadeſt, deſcends to cover ſome of the antrum highmorianum; the anterior riſes up to join the os unguis, and to make part of the lacrymal duct.

Below the ſpongy bones already mentioned, there are ſometimes two others, one in each noſtril, which ſeems to be a production of the ſides of the maxillary ſinus turned downwards. When this third ſort of ſpongy bones are found, the middle one of the three in each noſtril is the largeſt, and the loweſt is the ſmalleſt. Beſides all theſe, there are often ſeveral other ſmall bones ſtanding out in the noſtrils; that, from their ſhape, might alſo deſerve the name turbinata; but are uncertain in their bulk, ſituation, and number, according to Santorini.

The names of theſe bones ſufficiently declare their ſpongy ſubſtance, which has no firm external plate covering it.

They are joined to the oſſa maxillaria, palati, and unguis, in old ſubjects, by a firm union of ſubſtance; and as this happens alſo frequently in people of no great age, Santorini and ſome anatomiſts are of opinion, that they ſhould be eſteemed part of the palate bones; others think with Hunauld, that ſince their upper edges are continued by a plate to a part of the os ethmoides, they ought to be eſteemed a part of this bone.

Their uſe is, to ſtraiten the noſtrils, to afford a large ſurface for extending the organ of ſmelling, to cover part of the antra maxillaria, and to aſſiſt in forming the under part of the lachrymal ducts, the orifices of which, into the noſe, are concealed by theſe bones.

The oſſa turbinata are nearly complete in a new-born infant.

The VOMER, or bone reſembling a plough-ſhare, is the thirteenth of the upper jaw without a fellow, forming the lower and back parts of the partition of the noſe.

The figure of this bone is an irregular rhomboid; its ſides are flat and ſmooth. Its poſterior edge appears in an oblique direction at the back part of the noſtrils. The upper one is firmly united to the baſe of the ſphenoid bone, and to the naſal plate of the ethmoid; and when it can be got ſeparated, is hollow, for receiving the proceſſus azygos of the ſphenoid. The anterior edge has a long furrow in it, where the middle cartilage of the noſe enters. The lower edge is firmly united to the naſal ſpines of the maxillary and palate bones. Theſe edges of this bone are much thicker than its middle, which is as thin as the fineſt paper, by which, and the firm union or connection this bone has above and below, it can very ſeldom be ſeparated entire in adults: but, in a child, it is much more eaſily ſeparated entire, and its ſtructure is more diſtinctly ſeen; wherefore I ſhall examine all its parts in ſuch a ſubject.

Its ſituation is not always perpendicular, but often inclined and bended to one ſide, as well as the naſal plate of the ethmoid bone.

The vomer is convex at its upper part, and then is ſtreight, as it is extended downwards and forwards, where it is compoſed of two plates, the edge of which has a great number of ſmall proceſſes, diſpoſed ſomewhat like the teeth of a ſaw, but more irregularly, and ſeveral of them are reflected back. Between theſe plates a deep foſſa is left, which, ſo far as the top of the curvature, is wide, and has ſtrong ſides, for receiving the proceſſus azygos of the ſphenoid bone. Beyond the arch forwards the foſſa is narrower and ſhallower gradually to the point of the bone, receiving for ſome way the naſal lamella ethmoidea; which, after the oſſification is complete, is ſo cloſely united to the vomer, by the little proceſſes piercing into its ſubſtance, as to prevent any ſeparation; on which account it has been eſteemed by Lieutaud, and ſome anatomiſts, a part of the ethmoid bone. The middle cartilage of the noſe fills up what remains of the foſſa at its fore-part. The poſterior edge of the vomer, which appears above the back part of the palate bones, is broader above; but as it deſcends forwards, becomes thinner, though it is ſtill ſolid and firm.

The lower edge of this bone, which reſts on the naſal ſpine of the palate and maxillary bones, has a little furrow on each ſide of a ſmall middle ridge, anſwering to the ſpines of the bones of different ſides, and the interſtice between them. This edge, and the upper one, meet in the pointed fore-end of this bone.

The body of the vomer has a ſmooth ſurface, and ſolid, but thin ſubſtance; and towards its ſides, where it is thickeſt, ſome cancelli may be obſerved when the bone is broken.

It is joined above to the ſphenoid and ethmoid bones, and to the middle cartilage of the noſe, by ſchindyleſis; below, to the maxillary and palate bones, by the ſpinous future.

The vomer divides the noſtrils, enlarges the organ of ſmelling, by allowing place for expanding the membrane of the noſe on its ſides, and ſuſtains the palate-plates of the maxillary and palate bones, which otherwiſe might be in hazard of being preſſed into the noſtrils; while the vomer is ſecured from ſhuffling to one ſide or other by the double ſchindyleſis, by which it is joined to the bones above and below.

Theſe then are all the bones which compoſe the upper jaw, except the teeth, which are ſo much a kin to thoſe of the lower jaw, that I chuſe to make one deſcription ſerve for both; in which the differences obſervable in them ſhall be remarked, after the ſecond part of the face, the lower jaw, is examined; becauſe the ſtructure of the teeth cannot be well underſtood, until the caſe in which they are ſet is explained.

The MAXILLA INFERIOR, or the lower jaw, conſiſts only of one moveable bone, and ſixteen teeth incaſed in it.

This bone, which is ſomewhat like the Greek letter *υ*, is ſituated at the lower part of the face, ſo as its convex middle part is forwards, and its legs are ſtretched back. It is commonly divided into the chin, ſides, and proceſſes. The chin is the middle fore part; the extent of which, to each ſide, is marked on the external ſurface by the holes obſervable there; and internally, by the beginning of an oblique ridge. Beyond theſe, the ſides appear, and are continued till the bone, by bending upwards, begins to form the proceſſes.

On the fore-part of the chin, a tranſverſe ridge appears in the middle; on each ſide of which the muſculi quadrati, or depreſſores labii inferioris, and the levatores labii inferioris, depreſs the bone: and below theſe prints, a ſmall riſing may be obſerved, where the depreſſores commence. On the back part of the chin, ſometimes three, always two, ſmall protuberances appear in the middle. To the uppermoſt, when it is ſeen, the frænum of the tongue is connected. From the middle one, the muſculi genioglosſi riſe; and from the loweſt the geniohyoidei have their origin. Below the laſt, we ſee two rough ſinuoſities formed by the digaſtric muſcles.

At the lower and fore-part of the external ſurface of each ſide of the lower jaw, a ſmall eminence may be obſerved, where the depreſſor labiorum communis riſes. Near the upper edge of the ſide, a ridge runs lengthways, to which the under part of the muſculus buccinator is connected. Internally, towards the upper edge of each ſide, another ridge appears, from which the mylohyoidei have their origin, and to which the internal membrane of the gums adheres.

In the upper edge of both chin and ſides are a great many deep pits or ſockets, for receiving the roots of the teeth. The number and magnitude of theſe ſockets are various, becauſe of the different number, as well of the teeth themſelves, as of their roots, in different people. Theſe ſockets in this lower jaw, as well as in the upper one, are leſs deep as old age comes on When freed from the teeth by any means, they are ſome time after filled up with an oſſeous net-work, which at laſt becomes entirely ſolid, and as ſmooth as any part of the bone; ſo that in a great many old jaws one cannot obſerve a veſtige of the ſockets; but then the jaw becomes leſs, and much narrower, as Veſalius obſerves. Hence we may know why the chin and noſe of toothleſs people are much nearer than before the teeth were loſt; while their lips either fall in towards the mouth, or ſtand prominent forwards. Fallopius firſt remarked, that whenever teeth are protruded, new ſockets are formed. The lower edge of the chin and ſides is ſmooth and equal, and is commonly called the baſe of the lower jaw. The ends of the baſe, where the jaw turns upwards, are called its angles; the external ſurface of each of which has ſeveral inequalities upon it, where the maſſeter muſcle is inſerted; as the internal ſurface alſo has, where the pterygoideus internus is inſerted, and a ligament extended from the ſtyloid proceſs of the temporal bone is fixed.

The proceſſes are two on each ſide. The anterior, ſharp, thin, coronoid ones, have the crotaphite muſcles inſerted into them. The poſterior proceſſes, or condyles, terminate in an oblong ſmooth head, ſupported by a cervix. The heads, whoſe greateſt length is tranſverſe, and whoſe convexity is turned forwards, are tipped with a cartilage, as the articulated parts of all other moved bones are. The fore-part of the root and neck of the condyloid proceſſes are a little hollow and rough, where the external pterygoid muſcles are inſerted.

The holes of the lower jaw are two on each ſide; one at the root of the proceſſes internally, where a large branch of the third branch of the fifth pair of nerves enters with an artery, and a vein returns. A ſmall ſharp proceſs frequently juts out backwards from the edge at the fore-part of this hole, to which a ligament extended from the temporal bone is fixed, deſcribed by Weitbrecht, which ſaves the nerve and veſſels from being too much preſſed by the pterygoid muſcles. From the lower ſide of this hole, either a ſmall ſuperficial canal or a furrow deſcends, according to Palfyn, where a branch of the nerve is lodged, in its way to the mylohyoideus muſcle and ſublingual gland. The other hole is external, at the confines of the chin, where branches of the nerve and veſſels come out. The canal betwixt theſe two holes is joined in the middle of the ſubſtance of the bone, and is pierced by a great number of ſmall holes, by which the nerves and blood veſſels of the cancelli and teeth paſs. This canal is continued a little farther than the external hole of the chin. On account of the veſſels and nerves in the lower jaw, fractures of this part may be attended with dangerous ſymptoms.

The ſurface of the lower jaw is hard and firm, except at the ſpongy ſockets, where however it is ſtronger than the upper jaw. Its internal ſubſtance is cellular, without any ſolid partition between the cancelli in its middle. At the baſe, eſpecially of the chin, where this bone is moſt expoſed to injuries, the ſolid ſides of it are thick, compact, and hard.

The lower jaw generally receives the roots of ſixteen teeth into its ſockets, by gomphoſis; and its condyloid proceſſes covered with cartilage, are articulated with the temporal bones, in a manner that is not commonly deſcribed right: for, as was already mentioned in the deſcription of the temporal bones, not only the fore-part of the cavity between the zygomatic auditory and vaginal proceſſes, but alſo the adjoining tubercle at the root of the zygomatic of each os temporum, is covered with a ſmooth cartilage for this articulation. Here alſo an intermediate moveable cartilage is placed, which being thin in the middle, and thick at the edges, is concave on both ſides; and is connected ſo firmly by ligaments to each condyle, as to follow the motions of the condyle; and ſo looſely to the temporal bone, as readily to change its ſituation from the cavity to the tubercle, and to return again; while the common ligament of the articulation affords ſpace enough for ſuch a change of place backwards and forwards; but, like other ligament of the joints by ginglimus, is ſtrong and ſhort at the ſides, to confine the lateral motions.

When therefore the teeth of both jaws coincide, the condyles are lodged ſecurely in the temporal cavities; but their motions to either ſide muſt be confined both by the firmneſs of the ligaments, and the riſing brims which are on each ſide of the cavities.

When the jaw is brought directly forwards, the condyle and intermediate cartilages deſcend and advance forwards upon the tubercles. In this ſituation, the lateral motions are a little more free than in the former one, from the want of riſing brims to ſtop the condyles. When the fore teeth of the lower jaw are moved forwards, and to one ſide, the condyle of the oppoſite ſide is either advanced from the cavity to the tubercle, while the condyle of the ſame ſide remains in the cavity; or if both condyles are on the tubercles, when the jaw is moved obliquely to one ſide, the condyle of the ſide to which the motion is made, ſlides back from the tubercle to the cavity. When the mouth is opened by the deſcent of the lower jaw, the fore part of it, where the depreſſing muſcles are fixed, is drawn backwards as well as downwards, while reſiſtance is made to the angles moving backwards by the maſſeter and internal pterygoid muſcles; and, at the ſame time, the external pterygoids draw the condyles and their moveable cartilages forwards

wards upon the tubercles, and the axis of motion of the bone is a little above its angles. But in this ſituation there is leſs reſiſtance than in any other, to the condyles luxating forwards; a diſeaſe which ſeldom happens, except when people are gaping too wide; and therefore the common practice of nurſes, who ſupport the jaw of infants when they are yawning, is reaſonable. In chewing, there is a ſucceſſion of the above motions.

A general remark may be made here, that wherever moveable cartilages are found in joints, either the articulated bones are of ſuch a figure, or ſo joined and fixed by their ligaments, that little motion would be allowed without ſuch cartilages; or elſe ſome motions are neceſſary to the right uſe of the member, which the form of the articulation would not otherwiſe admit of. This will more fully appear, after the other joints with ſuch cartilages are deſcribed.

In a child born at the full time, the lower jaw is compoſed of two bones, connected by a thin cartilage in the middle of the chin, which gradually oſſifies, and the two bones intimately unite. In each of theſe bones there are five or ſix ſockets for teeth, as in the upper jaw.

After having thus deſcribed the incaſement of the teeth, the inſertion of ſo many muſcles of the tongue, and of the os hyoides, the connection of the membrane of the tongue to the maxillary bone, and the motions of this bone, it is eaſily ſeen, that the lower jaw muſt be a principal inſtrument in manducation, deglutition, and ſpeech.

The TEETH are the hard white bodies placed in the ſockets of both jaws. Their number is generally ſixteen above, and as many below; though ſome people have more, others have fewer.

The broad thick part of each tooth which appears without the ſocket, is the baſe or body. The ſmaller proceſſes ſunk into the maxillæ, are the root or fangs, which become gradually ſmaller towards the end fartheſt from the baſe, or are nearly conical, by which the ſurface of their ſides divides the preſſure made on the baſes, to prevent the ſoft parts, which are at the ſmall points of the ſockets, to be hurt by ſuch preſſure. At the place where the baſe ends, and the roots begin, there is generally a ſmall circular depreſſion, which ſome call the neck or collar.

Without the gums the teeth are covered with no membrane, and they are ſaid to have no proper perioſteum within the ſockets; but that is ſupplied by the reflected membrane of the gums, which, after a ſucceſsful injection, may be evidently ſeen in a young ſubject, with the veſſels from it penetrating into the ſubſtance of the teeth; and it may be diſcovered in any tooth recently pulled, by macerating it in water, as Cowper remarks. The adheſion of this membrane to theſe roots is ſtrengthened by the ſmall furrows obſervable on them.

Each tooth is compoſed of its cortex, or enamel, and an internal bony ſubſtance. The cortex has no cavity or place for marrow, and is ſo ſolid and hard, that ſaws or files can with difficulty make impreſſion on. It is thickeſt upon the baſe; and gradually, as the roots turn ſmaller, becomes thinner, but not proportionally to the difference of the ſize of the baſe and roots. The fibres of this enamel are all perpendicular to the internal ſubſtance, and are ſtreight on the baſe; but at the ſides are arched, with a convex part towards the roots, as deſcribed in Havers's Oſteology, which makes the teeth reſiſt the compreſſion of any hard body between the jaws, with leſs danger of breaking theſe fibres, than if they had been ſituated tranſverſely. The ſpongy ſockets in which the teeth are placed, likewiſe ſerve better to prevent ſuch an injury, than a more ſolid baſe would have done. Notwithſtanding the great hardneſs of this cortex, it is waſted by manducation. Hence the ſharp edges of ſome teeth are blunted and made broad, while the rough ſurfaces of others are made ſmooth and flat.

The bony part of the teeth has its fibres running ſtreight, according to the length of the teeth. When it is expoſed to the air, by the breaking or falling off of the hard cortex, it ſoon corrupts; and thence carious teeth are often all hollow within, when a very ſmall hole only appears externally.

The teeth have canals formed in their middle, wherein their nerves and blood-veſſels are lodged; which they certainly need, being conſtantly waſted by the attrition they are ſubjected to in manducation, and for their further growth, not only after they firſt appear, but even in adults, as is evident when a tooth is taken out; for then the oppoſite one becomes longer, and thoſe on each ſide of the empty ſocket turn broader; ſo that when the jaws are brought together, it is ſcarce obſervable where the tooth is wanting, as Ingraſſias obſerves.

The veſſels are eaſily traced, ſo long as they are in the large canal, but can ſcarce be obſerved in their diſtribution from that to the ſubſtance of the teeth of adults. Ruyſch however, affirms, that after injection he could trace the arteries into the hardeſt part of the teeth: and Leeuwenhoeck ſuſpected the fibres of the cortex to be veſſels. In children he has frequently injected the veſſels of the teeth as far as their baſe: and in ſuch as are not entirely oſſified, one can, with a lucky injection, fill ſo many veſſels, as to make both the outſide and inſide of the cortical part appear perfectly red. This plentiful ſupply of veſſels muſt expoſe the teeth to the ſame diſorders that attack other vaſcular parts; and ſuch teeth as have the greateſt number of veſſels, muſt have the moſt numerous chances of being ſeized with theſe diſeaſes.

Every root of each tooth has ſuch a diſtinct canal, with veſſels and nerves in it. Theſe canals in the teeth with more than one root, come nearer each other, as they approach the baſe of the tooth; and at laſt are only ſeparated by very thin plates, which being generally incompleat, allow a communication of all the canals; and frequently one common cavity only appears within the baſe, in which a pulpy ſubſtance, compoſed of nerves and veſſels, is lodged. The condition therefore, of the nerves here, bears a ſtrong analogy to that of the cutaneous nerves, which ſerve for the ſenſation of touching.

The entry of the canals for theſe veſſels, is a ſmall hole, placed a little on one ſide of the extreme point of each root: ſometimes, eſpecially in old people, this hole is intirely cloſed up, and conſequently the nerves and blood-veſſels are deſtroyed, as La Hire has remarked in the hiſtory of the Royal Academy of Sciences for 1699.

The teeth are ſeen for a conſiderable time in form of mucus contained in a membrane; afterwards in a thin cortical plate, and ſome few oſſeous layers appear within the membrane, with a large cavity filled with mucus in the middle; and gradually this exterior ſhell turns thicker, the cavity decreaſes, the quantity of mucus is leſſened, and this induration proceeds till all the body is formed; from which the roots are afterwards produced.

In young ſubjects, different ſtamina or rudiments of teeth are to be obſerved. Thoſe next the gums hinder ordinarily the deeper ſeated ones from making their way out, while theſe prevent the former from ſending out roots, or from entering deep into the bony ſockets of the jaws, by which they come to be leſs fixed.

Children are ſeldom born with teeth; but at two years of age they have twenty; and their number does not increaſe till they are about ſeven years old, when the teeth that firſt made their way through the gums are thruſt out by others that have been formed deeper in the jaw, and ſome more of the teeth begin to diſcover themſelves farther back in the mouth. About fourteen years of age, ſome more of the firſt crop are ſhed, and the number is increaſed. This ſhedding of the teeth is of good uſe; for if the firſt had remained, they would have ſtood at a great diſtance one from another; becauſe the teeth are too hard in their outer cruſt, to increaſe ſo faſt as the jaws do. Whereas both the ſecond layer, and the teeth that come out late, meeting, while they are ſoft, with a conſiderable reſiſtance to their growth in length, from thoſe ſituated upon them, neceſſarily come out broad, and fit to make that cloſe guard to the mouth, which they now form.

The teeth are joined to the ſockets by gomphoſis, and the gums contribute to fix them there, as is evident by the teeth falling out when the gums are any way deſtroyed, or made too ſpongy, as in the ſcurvy or ſalivations; whence ſome, with Drake, claſs this articulation with the ſyſſarcoſis.

The uſes of the teeth are to maſticate our aliments, and to aſſiſt us in the pronunciation of ſeveral letters.

Though the teeth ſo far agree in their ſtructure, yet, becauſe of ſome things wherein they differ, they are generally divided into three claſſes, viz. *inciſores*, *canini*, and *molares*.

The inciſores are the four fore-teeth in each jaw, receiving their name from their office of cutting our aliment; for which they are excellently adapted, being each formed into a ſharp cutting edge at their baſe, by their fore ſide turning inward there, while they are ſloped down and hollowed behind, ſo that they have the form of wedges; and therefore their power of acting muſt be conſiderably increaſed. Du Verney, in his letter on Oſteology, ſays: Seeing in the action of the inciſores, a perpendicular compreſſion is only neceſſary, without any lateral motion, they are not ſo firmly fixed in their ſockets as the other teeth are, each having only one ſhort root, but that is broader from before backwards, than to either ſide, to have the greateſt ſtrength, where it is expoſed to the ſtrong force applied to it.

The inciſores of the upper jaw, eſpecially the two middle ones, are broader and longer generally than thoſe of the under jaw.

In a new-born infant, the outer ſhell of the body of theſe teeth is only hardened. Afterwards, when the ſtamina of two ſets are formed, each has its own ſocket; thoſe neareſt to the edge of the gums being placed more forward, and the others are lodged farther back within the jaw bones.

The canine, from the reſemblance to dog's tuſks, are one on each ſide of the inciſores in each jaw; the two in the upper jaw are called eye-teeth, from the communication of the nerves which is ſaid to be betwixt them and the eyes. The two in the lower jaw are named angular, or wike-teeth, becauſe they ſupport the angles of the mouth.

The canine are broader, longer, and ſtronger, than the inciſores. Their baſes are formed into a ſharp edge, as the inciſores are; only that the edge riſes into a point in the middle. Fauchard ſays, each of them has generally but one long root, though ſometimes they have two. The roots are crooked towards the end. The canine of the upper jaw are larger, longer, and with more crooked roots, than thoſe of the under jaw. The form of their baſe is fit both for piercing and cutting; and the long crooked root of each, makes it ſecure in the ſocket.

The canine teeth of a child are in much the ſame condition as the inciſores are.

The dentes molares, or grinders, which have got their name becauſe they grind our food, are generally five in each ſide of each jaw, in all twenty. Their baſes are broader, more ſcabrous, and with a thinner cortical ſubſtance than the other teeth. They have alſo more roots; and as thoſe roots generally divaricate from each other, the partitions of the ſockets between them bear a large ſhare of the great preſſure they ſuffer, and bind it to act on their points.

The baſe of the firſt grinder has an edge pointed in the middle, on its outſide, reſembling the canine; from which it ſlopes inwards, till it riſes again into a point. It has generally but one root, which ſometimes is long and crooked at its point.

The ſecond dens molaris has two points on its baſe, riſing near equally on its out and inſide. It has two roots, either ſeparate or run together, but ſhorter than the root of the firſt. Theſe two anterior grinders are much ſmaller than the three that are placed farther back in the mouth.

The third and fourth are very broad in their baſes, with four or five points ſtanding out; and they have three or more roots.

The fifth, called commonly dens ſapientiæ, from its coming thro' the gums later than the other grinders, has four points on its baſe, which is not ſo large as the baſe of the third and fourth, and its roots are leſs numerous.

The inciſores of the upper-jaw being broader than thoſe of the lower jaw, make the ſuperior grinders to be placed ſo much farther back than the lower ones, that when they are brought together, by ſhutting the mouth, the points of the grinders of the one jaw enter into the depreſſions of the oppoſite grinders, and they are all equally applied to each other, notwithſtanding the inequality of the ſurface.

The numerous roots of the dentes molares prevent their looſening by the lateral preſſure they ſuffer in grinding; and as the ſockets in the upper-jaw are more ſpongy, and the teeth are more liable, by their ſituation, to fall out, the grinders there have more numerous and more ſeparated roots than in the lower-jaw, as Galen and Fauchard obſerve. The number, however, of the roots of the teeth of both jaws is very uncertain; ſometimes they are more, ſometimes fewer; frequently ſeveral roots are joined together; at other times they are all diſtinct. The diſpoſition of ſuch as are diſtinct is alſo various; for in ſome the roots ſtand out ſtreight, in others they ſeparate, and in others again they are crooked inwards. When the roots are united we can ſtill diſtinguiſh them, by remarking the number of ſmall holes at their points, which determine the number of roots each tooth ought to be reckoned to have.

At the time of birth, only two dentes molares in each jaw have begun to oſſify, and that at little more than the baſe, which has ſeveral ſharp points ſtanding out from it. The temporaneous grinders are placed more directly upon the internal ſet than the other two claſſes are; ſometimes there is a piece of the bone of the jaws between the two ſets; in other children, the two ſets have no bone interpoſed between them.

According to the diviſion made of the ſkeleton, we ſhould now proceed to the deſcription of the trunk of the body; but muſt firſt conſider a bone which cannot well be ſaid to belong to either the head or the trunk, nor is it immediately joined to any other, and therefore is very ſeldom preſerved with ſkeletons. However, it is generally deſcribed by authors after the bones of the face. In obedience, therefore, to the prevailing method, I ſhall next examine the ſtructure of

The Os Hyoides, which is ſituated horizontally between the root of the tongue and the larynx. It is properly enough named hyoides, from the reſemblance it bears to the Greek letter υ, and may, for a clearer demonſtration of its ſtructure, be diſtinguiſhed into its body, cornua, and appendices.

The body is the middle broad part, convex before, and hollow behind. The convex fore-part is divided into two, by a ridge; into the middle of which the mylo-hyoidei, and into the ſides the ſtylo-hyoidei muſcles are inſerted. Above the ridge, the bone is horizontal, but pitted in the middle by the inſertion of the two genio-hyoidei muſcles, and a little hollowed more laterally by the baſo-gloſſi. Below the ridge it is convex, but a little flatted in the middle by the ſterno-hyoidei, and pitted more externally by the coracohyoidei. The concavity behind the faces backwards and downwards to receive the thyroid cartilage, when the larynx and the os-hyoides are pulled towards each other by the action of the ſterno-hyoidei and hyothyroidei muſcles; and, to its upper edge, the ligamentous membranes of the epiglottis, tongue, and thyroid-cartilage are fixed.

The horns of the os-hyoides are ſtretched backwards from each ſide of its body, where often a ſmall furrow points out the former ſeparation; for, in young ſubjects, the body and horns are not one continued ſubſtance, as they come afterwards to be in adults. Theſe horns are not always ſtreight, nor of equal length; their two plain ſurfaces ſtand obliquely ſloping from above outwards and downwards, into the external, the cerato-gloſſus is inſerted above; and the thyro-hyoideus muſcle below: and, to the one behind, the ligamentous membrane of the tongue and larynx adheres. Each of the horns becomes gradually ſmaller, as it is extended from the baſe, but ends in a round tubercle, from which a moveable cartilage ſtands out, which is connected to the upper proceſs of the thyroid cartilage.

Where the body of the os-hyoides joins on each ſide with its cornua, a ſmall ſtyliform proceſs, called appendix, riſes upwards and backwards, into which the muſculi ſtylo-hyoidei alteri, and part of the hyo gloſſi muſcles are fixed. From each of them a ligament is ſometimes extended to the ſtyloid proceſs of the temporal bones, to keep the os-hyoides from being drawn too much forwards or downwards. The part of the ligament next to theſe proceſſes ſometimes forms into ſeveral cartilages, which afterwards oſſify in old people. Ruyſch, in his Adverſaria Anat. p. 3, ſect. ix. ſays, that he has ſeen this oſſification continued as far up as the ſtyloid proceſſes, which were therefore joined to the os-hyoides by anchyloſis.

The ſubſtance of the os-hyoides is cellular, but covered with a firm external plate, which is of ſufficient ſtrength to bear the actions of ſo many muſcles as are inſerted in it.

It is not articulated with any bone of the body, except by means of the muſcles and ligaments mentioned.

The uſe of the os-hyoides, is to ſerve as a ſolid lever for the muſcles to act with, in raiſing or depreſſing the tongue and larynx, or in enlarging and diminiſhing the capacity of the fauces.

At birth this bone is in a cartilaginous ſtate, excepting a ſmall point of bone in the middle of its body, and in each of the horns. The appendices frequently remain cartilaginous many years.

The BONES *of the* TRUNK.

The trunk conſiſts of the ſpine, pelvis, and thorax.

The ſpine is the long pile of bones extended from the condyles of the occiput to the end of the rump. It ſomewhat reſembles two unequal pyramids joined in a common baſe. It is not, however, ſtreight, for its upper part being drawn backwards by ſtrong muſcles, it gradually advances forwards, to ſupport the œſophagus, veſſels of the head, &c. Then it turns backwards to make place enough for the heart and lungs. It is next bended forwards to ſupport the viſcera of the abdomen. It afterwards turns backwards, for the enlargement of the pelvis: and laſtly, it is reflected forwards, for ſuſtaining the loweſt great gut.

The ſpine is commonly divided into true and falſe vertebres, the former conſtituting the long upper pyramid, which has its baſe below, while the falſe vertebres make the ſhorter lower pyramid, whoſe baſe is above.

The true vertebres are the twenty-four upper bones of the ſpine, on which the ſeveral motions of the trunk of our bodies are performed, from which uſe they have juſtly got their name.

Each of theſe vertebres is compoſed of its body and proceſſes.

The body is the thick, ſpongy forepart, which is convex before, concave backwards, horizontal, and plain in moſt of them above and below. Numerous ſmall holes, eſpecially on the fore and back part of their ſurface, give paſſage to their veſſels, and allow the ligaments to enter their ſubſtance. The edges of the body of each vertebre are covered, eſpecially at the fore-part, with a ring of bone firmer and more ſolid than the ſubſtance of the body any where elſe. Theſe rings ſeem to be joined to the vertebres, in the form of epiphyſes, but are alledged by Fallopius, and ſome others, to be the ligament oſſified. They are of great uſe in preventing the ſpongy bodies from being broken in the motions of the trunk.

Between the bodies of each two adjoining vertebres, a ſubſtance between the nature of ligament and cartilage is interpoſed, which ſeems to conſiſt of concentrical curve fibres, when it is cut horizontally; but when it is divided perpendicularly, the fibres appear oblique and decuſſating each other. The outer part of the inter-vertebral ligaments is the moſt ſolid and hard; and they gradually become ſofter till they are almoſt in the form of a glairy liquor in the center; and therefore theſe ſubſtances were not improperly called mucous ligaments by Galen and the ancients. The external fibrous part of each is capable of being greatly extended, and of being compreſſed into a very ſmall ſpace, while the middle fluid part is incompreſſible, or nearly ſo; and the parts of this ligament between the circumference and center approach in their properties to either, in proportion to their more ſolid or more fluid texture. The middle point is, therefore, a prop or pivot on which the motion of a ball and ſocket may be made, with ſuch a gradual yielding of the ſubſtance of the ligament in whichever direction our ſpines are moved, as ſaves the body from violent ſhocks, and their dangerous conſequences. This ligamento-cartilaginous ſubſtance is firmly fixed to the horizontal ſurfaces of the bodies of the vertebres, to connect them, in which it is aſſiſted by a ſtrong membranous ligament, which lines all their concave ſurface, and by a ſtill ſtronger ligament that covers all their anterior convex ſurface.

We may lay it down as a general rule, notwithſtanding ſome exceptions, that the bodies of the vertebres are ſmaller, and more ſolid above, but as they deſcend, they appear larger and more ſpongy; and that the cartilages between them are thick, and the ſurrounding ligaments ſtrong in proportion to the largeneſs of the vertebres, and to the quantity of motion they perform: by which diſpoſition the greater weight is ſupported on the broadeſt, beſt, ſecureſt baſe, and the middle of our body is allowed a large and ſecure motion.

From each ſide of the body of each vertebre a bony bridge is produced backwards, and to a ſide; from the poſterior end of which one ſlanting proceſs riſes, and another deſcends; the ſmooth, and what is generally the flatteſt ſide of each of theſe four proceſſes, which are called the oblique, is covered with a ſmooth cartilage; and the two lower ones of each vertebre are fitted to, and articulated with the two upper or aſcending oblique proceſſes of the vertebre below, having their articular ligaments fixed into the rough line round their edges.

From between the oblique proceſſes of each ſide the vertebre is ſtretched out laterally into a proceſs, that is named tranſverſe.

From the back part of the roots of the two oblique, and of the tranſverſe proceſs of each ſide, a broad oblique bony plate is extended backwards, where theſe meet, the ſeventh proceſs of the vertebres takes its riſe. This being generally ſharp pointed and narrow edged, has therefore been called the ſpinal proceſs, from which this whole chain of bones has got its name.

Beſides the common ligament which lines all the internal ſurface of the ſpinal proceſſes, as well as of the bodies, there are particular ligaments that connect the bony bridges and proceſſes of the contiguous vertebres together.

The ſubſtances of the proceſſes is conſiderably ſtronger and firmer, and has a thicker external plate than the bodies of the vertebres have.

The ſeven proceſſes form a concavity at their fore-part, which joined to the one at the back-part of the bodies, makes a great hole, and the holes of all the vertebres form a long, large conduit, for containing the ſpinal marrow. In the upper and lower edge of each lateral bridge, there is a notch. Theſe are ſo adapted to each other in the contiguous vertebres, as to form a round hole in each ſide between each two vertebres, through which the nerves that proceed from the ſpinal marrow and its blood veſſels paſs.

The articulations of theſe true vertebres are plainly double; for their bodies are joined by the intervening cartilage above deſcribed, and their oblique proceſſes being tipped with cartilages, are ſo connected by their ligaments, as to allow a ſmall degree of motion to all ſides. Hence it is evident, that their center of motion is altered in different poſitions of the trunk, for when we bow forwards, the upper moved part bears entirely on the bodies of the vertebres: if we bend back, the oblique proceſſes ſupport the weight: if we recline to one ſide, we reſt upon the oblique proceſſes of that ſide, and part of the bodies: if we ſtand erect, all the bodies and oblique proceſſes have their ſhare in our ſupport.

Hence it follows, 1ſt, That becauſe the joints, of which the ſpine is compoſed, are ſo numerous, the ſpinal marrow, nerves, blood-veſſels, &c. are not liable to ſuch compreſſion and over-ſtretching in the motion of the trunk of the body, as they would otherwiſe be; ſince ſeveral vertebres muſt be concerned in every motion of the ſpine; and, therefore, as Galen remarks, a very ſmall curvature is made at the conjunction of any two vertebres. 2dly, That an erect poſture is the ſureſt and firmeſt, becauſe the ſurface of the contact of the fulcra is largeſt, and the weight is moſt perpendicular to them, as Pauw juſtly obſerves. 3dly, That the muſcles which move the ſpine, act with greater force in bringing the trunk to an erect poſture, than in drawing it to any other; for in bending forwards, backwards, or to a ſide, the muſcles, which perform any of theſe actions, are nearer the center of motion, conſequently the lever, with which they act, is ſhorter, than when the center of motion is on the part of the vertebra, oppoſite to that where theſe muſcles are inſerted, which is the caſe in raiſing the trunk. This is extremely neceſſary, ſince in the deflections of the ſpine from a perpendicular bearing, the weight of the body ſoon inclines it which way we deſign; whereas, in raiſing us erect, this great weight muſt be more than counteracted. 4thly, In calculating the force exerted by the muſcles which move the ſpine, we ſhould always make allowance for the action of the cartilages between vertebres, which in every motion from an erect poſture, muſt be ſtretched on one ſide, and compreſſed on the other, to both which they reſiſt; whereas, in raiſing the trunk, theſe cartilages, according to Borelli, aſſiſt by their ſpongy force. 5thly, We are hence naturally led into the reaſon of our heighth of ſtature increaſing in the morning, and diminiſhing at night, as remarked in the Philoſophical Tranſactions; for the intermediate cartilages of the vertebres being preſſed all day long by the weight of our body, become more compact and thin in the evening; but when they are relieved from this preſſure in the night, they again expand themſelves to their former thickneſs; and ſeeing the bulk of any part muſt vary according to the different diſtention or repletion of the veſſels compoſing it, we may hence underſtand how we become taller after a plentiful meal, and decreaſe after faſting, or evacuations. 6thly, From the different articulations of the bodies, and oblique proceſſes of the vertebres, and the different ſtrength of the ligaments, it is plain that they are formed ſo as to allow much larger motion forwards than backwards; this laſt being of much leſs uſe, and, according to Galen, might be dangerous, by over-ſtretching the large blood veſſels that are contiguous to the bodies of the vertebres. 7thly, The intervertebral cartilages ſhrivelling as they become more ſolid by age, is the cauſe why old people generally bow forwards, and cannot raiſe their bodies to ſuch an erect poſture as they had in their youth.

The true vertebres ſerve to give us an erect poſture; to allow ſufficient and ſecure motion to the head, neck, and trunk of the body, and to ſupport and defend the bowels, and other ſoft parts.

At the ordinary time of birth, each vertebre conſiſts of three bony pieces, connected by cartilages; to wit, the body, which is not fully oſſified, and a long crooked bone on each ſide, on which we ſee a ſmall ſhare of the bony bridge, the oblique proceſſes complete, the beginning tranſverſe proceſſes, and the oblique plate, but no ſpinal proceſſes, ſo that the teguments are in no danger of being hurt by the ſharp ends of theſe ſpinal proceſſes, while a child is in its bended poſture in the womb, nor while it is ſqueezed in the birth.

From this general mechaniſm of the ſpine, an account is eaſily deduced of all the different preternatural curvatures which the ſpine is capable of: for if one or more vertebres, or their cartilages, are of unequal thickneſs in opoſite ſides, the ſpine muſt be reclined over to the thinner ſide; which now ſuſtaining the greateſt ſhare of the weight muſt ſtill be more compreſſed, conſequently hindered from extending itſelf in proportion to the other ſide, which being too much freed of its burthen has liberty to enjoy a luxuriant growth. The cauſes on which ſuch an inequality of thickneſs in different ſides of the vertebres depends, may vary; for either it may be owing to an over diſtention of the veſſels of one ſide, and from thence a preternatural increaſe of the thickneſs of that part; or which more commonly is the caſe, it may procreed from an obſtruction of the veſſels, by which the application of proper nouriſhment to the bony ſubſtance is hindered; whether that obſtruction depends on the faulty diſpoſition of the veſſels, or fluids, or if it is produced by an unequal mechanical preſſure, occaſioned by a paralytic weakneſs of the muſcles and ligaments, or by a ſpaſmodic over-action of the muſcles on any ſide of the ſpine, or by people continuing long, or putting themſelves frequently into any poſture declining from the erect one; in all theſe caſes one common effect follows, viz. the vertebres, or their cartilages, or both, turn thick on that ſide where the veſſels are ſtreightened or obſtructed: whenever any morbid curvature is thus made, a ſecond turn, but in an oppoſite direction to the former, muſt be formed; both becauſe the muſcles on the convex ſide of the ſpine being ſtretched muſt have a ſtronger natural contraction to draw the parts to which their ends are fixed, and becauſe the patient makes efforts to keep the center of gravity of the body perpendicular to its baſe, that the muſcles may be relieved from a conſtant, violent, and contractile ſtate, which always creates uneaſineſs and pain.

When once we underſtand how theſe crooked ſpines are produced, there is little difficulty in performing a juſt prognoſis; and a proper method of cure may be as eaſily contrived, which muſt vary as to the internal medicines, according to the different cauſes on which the diſeaſe depends; but one general indication muſt be purſued by ſurgeons, which is, to counteract the bending force, by increaſing the compreſſion on the convex part of the curvature, and diminiſhing it on the concave ſide. The manner of executing which in particular caſes muſt be different, and requires a very accurate examination of the circumſtances both of the diſeaſe and patient. In many ſuch caſes I have found ſome ſimple directions, as to poſtures in which the patient's body ſhould be kept, of very great advantage.

Though the true vertebres agree in the general ſtructure hitherto deſcribed, yet becauſe of ſeveral ſpecialities proper to a particular number, they are commonly divided into three claſſes, viz. cervical, dorſal, and lumbar.

The cervical are the ſeven uppermoſt vertebres, which are diſtinguiſhed from the reſt by theſe marks. Their bodies are ſmaller and more ſolid than any others, and flatted on the fore-part, to make way for the œſophagus; or rather this flat figure is owing to the preſſure of that pipe, and to the action of the longi colli and anterior recti muſcles. They are alſo flat behind, where ſmall proceſſes riſe, to which the internal ligaments are fixed. The upper ſurface of the body of each vertebra is made hollow, by a ſlanting thin proceſs which is raiſed on each ſide: the lower ſurface is alſo excavated, but in a different manner; for here the poſterior edge is raiſed a little, and the one before is produced a conſiderable way. Hence we ſee how the cartilages between thoſe bones are firmly connected, and their articulations are ſecure.

The cartilages between theſe vertebres are thick, eſpecially at their fore-part; which is one reaſon why the vertebres advance forward as they deſcend, and have larger motion.

The oblique proceſſes of theſe bones of the neck more juſtly deſerve that name than thoſe of any other vertebres. They are ſituated ſlanting, the upper ones having their ſmooth and almoſt flat ſurfaces facing obliquely backwards and upwards, while the inferior oblique proceſſes have theſe ſurfaces facing obliquely forewards and downwards.

The tranſverſe proceſſes of theſe vertebres are framed in a different manner from thoſe of any other bones of the ſpine; for beſides the common tranſverſe proceſs riſing from between the oblique proceſſes of each ſide, there is a ſecond one that comes out from the ſide of the body of each vertebre; and theſe two proceſſes, after leaving a circular hole for the paſſage of the cervical artery and vein, unite, and are conſiderably hollowed at their upper part, with riſing ſides, to protect the nerves that paſs in the hollow; and at laſt, each ſide terminates in an obtuſe point, for the inſertion of muſcles.

The ſpinal proceſſes of theſe cervical bones ſtand nearly ſtreight backwards, are ſhorter than thoſe of any other vertebres, and are forked, or double at their ends, and hence allow a more convenient inſertion to muſcles.

The thick cartilages between the bodies of theſe cervical vertebres, the obliquity of their oblique proceſſes, and the ſhortneſs and horizontal ſituation of their ſpinal proceſſes, all conſpire to allow them large motion.

The holes between the bony croſs bridges for the paſſage of the nerves from the ſpinal marrow, have their largeſt ſhare formed in the loweſt of the two vertebres, to which they are common.

So far moſt of the cervical vertebres agree; but they have ſome particular differences, which oblige us to conſider them ſeparately.

The firſt, from its uſe in ſupporting the head, has the name of atlas, and is called epiſtrophea, from the motion it performs on the ſecond.

The atlas, contrary to all the other vertebres of the ſpine, has no body; but inſtead of it, there is a bony arch. In the convex fore-part of which a ſmall riſing appears, where the muſculi longi colli are inſerted; and on each ſide of this protuberance, a ſmall cavity may be obſerved, where the recti interni minores take their riſe. The upper and lower parts of the arch are rough and unequal, where the ligaments that connect this vertebre to the occipital bone, and to the ſecond vertebre are fixed. The back part of the arch is concave, ſmooth, and covered with a cartilage, in a recent ſubject, to receive the tooth-like proceſs of the ſecond vertebre. In a firſt vertebre from which the ſecond has been ſeparated, this hollow makes the paſſage for the ſpinal marrow ſeem much larger than it really is: on each ſide of it a ſmall rough ſinuoſity may be remarked, where the ligaments going to the ſides of the tooth-like proceſs, of the following vertebre, are faſtened, and, on each ſide, a ſmall rough protuberance and depreſſion is obſervable, where the tranſverſe ligament, which ſecures the tooth-like proceſs in the ſinuoſity, is fixed, and hinders that proceſs from injuring the medulla ſpinalis in the flections of the head.

The atlas has as little ſpinal proceſs as body; but, inſtead thereof, there is a large bony arch, that the muſcles, which paſs over this vertebre at that place, might not be hurt in extending the head. On the back and upper-part of this arch, there are two depreſſions, where the recti poſtici minores take their riſe; and at the lower part are two other ſinuoſities, into which the ligaments, which connect this bone to the following one, are fixed.

The ſuperior oblique proceſſes of the atlas are large, oblong, hollow, and more horizontal than in any other vertebre. They riſe more in their external than internal brim, by which their articulations with the condyloid proceſſes of the os occipitis are firmer. Under the external edge of each of theſe oblique proceſſes, is the foſſa, or deep open channel, in which the vertebral arteries make the circular turn, as they are about to enter the great foramen of the occipital bone, and where the tenth pair of nerves goes out. In many bodies this foſſa is covered with bone. The inferior oblique proceſſes extending from within, outwards, and downwards, are large, concave, and circular; ſo that this vertebre, contrary to the other ſix, receives the bones with which it is articulated both above and below. The tranſverſe proceſſes here are not much hollowed, or forked, but are longer and larger than thoſe of any other vertebre of the neck, for the origin and inſertion of ſeveral muſcles; of which thoſe that ſerve to move this vertebre on the ſecond, have a conſiderable lever to act with, becauſe of the diſtance of their inſertion from the axis of revolution.

The hole for the ſpinal marrow is larger in this than in any other vertebre, not only on account of the marrow being largeſt here, but alſo to prevent its being hurt by the motions of this vertebre on the ſecond one. This large hole, and the long tranſverſe proceſſes, make this the broadeſt vertebre of the neck.

The condyles of the occipital bone move forwards and backwards on the ſuperior oblique proceſſes of this vertebre; but from the figure of the bones forming theſe joints it appears, that very little motion can here be allowed to either ſide, and there muſt be ſtill leſs circular motion.

In new-born children this vertebre has only the two lateral pieces oſſified; the arch, which it has at its fore-part, inſtead of a body, being cartilaginous.

The ſecond vertebre of the neck is called dentata, from the tooth-like proceſs on the upper part of its body. Some authors call it epiſtrophea, but improperly, ſince this deſignation is only applicable to the firſt, which moves on this as on an axis.

The body of this vertebre is ſomewhat of a pyramidal figure, being large, and produced downwards, eſpecially at its foreſide, to enter into a hollow of the vertebre below; while the upper part has a ſquare proceſs with a ſmall point ſtanding out from it. This it is that is imagined to reſemble a tooth, and has given name to the vertebre.

The ſide of this proceſs, on which the hollow of the anterior arch of the firſt vertebre plays, is convex, ſmooth, and covered with a cartilage: and it is of the ſame form behind, for the ligament, which is extended tranſverſely from one rough protuberance of the firſt vertebre to the other, and is cartilaginous in the middle, to move on it. A ligament likewiſe goes out in an oblique tranſverſe direction, from each ſide of the proceſſus dentatus, to be fixed at its other end to the firſt vertebre, and to the occipital bone; and another ligament riſes up from near the point of the proceſs to the os occipitis.

The ſuperior oblique proceſſes of this vertebre dentata are large, circular, very nearly in an horizontal poſition, and ſlightly convex, to be adapted to the inferior oblique proceſſes of the firſt vertebre. A moveable cartilage is ſaid by ſome authors to be interpoſed between theſe oblique proceſſes of the firſt and ſecond vertebres; but Monro could never find it. The inferior oblique proceſſes of this vertebra dentata anſwer exactly to the deſcription given of thoſe common to all the cervical vertebres.

The tranverſe proceſſes of the vertebra dentata are ſhort, very little hollowed at their upper part, and not forked at their ends; and the canals through which the cervical arteries paſs, are reflected outwards about the middle ſubſtance of each proceſs; ſo that the courſe of theſe veſſels may be directed towards the tranſverſe proceſſes of the firſt vertebre. Had this curvature of the arteries been made in a part ſo moveable as the neck is, while they were not defended by a bone, and fixed to that bone, ſcarce a motion could have been performed without the utmoſt hazard of compreſſion, and a ſtop put to the courſe of the liquids, with all its train of bad conſequences. Hence we obſerve the ſame mechaniſm ſeveral times made uſe of, when there is any occaſion for a ſudden curvature of a large artery. This is the third remarkable inſtance of it we have ſeen. The firſt was the paſſage of the carotids through the temporal bones; and the ſe-

cond

cond was that lately deſcribed in the vertebral arteries, turning round the oblique proceſſes of the firſt vertebre, to come at the great hole of the occipital bone.

The ſpinal proceſs of this vertebre is thick, ſtrong, and ſhort, to give ſufficient origin to the muſculi recti majores, and obliqui inferiores, and to prevent the contuſion of theſe and other muſcles in pulling the head back.

This ſecond vertebre conſiſts at the birth, of four bony pieces: for, beſides the three which I already mentioned as common to all the vertebres, the tooth-like proceſs of this bone is begun, at this time, to be oſſified in its middle, and is joined as an appendix to the body of the bone. Leſt this appendix be bended or diſplaced, nurſes ought to keep the heads of new-born children from falling too far backwards by ſtay-bands or ſome ſuch means, till the muſcles attain ſtrength ſufficient to prevent that dangerous motion.

When we are acquainted with the ſtructure and articulations of the firſt and ſecond vertebre, and know exactly the ſtrength and connection of their ligaments, there is no difficulty in underſtanding the motions that are performed upon or by the firſt; though this ſubject was formerly warmly diſputed by Euſtachius and ſome of the greateſt anatomiſts. We ſhall not enter into a detail of the reaſons advanced by either party; but to explain the fact, as any one may ſee it who will remove the muſcles, which, in a recent ſubject, hinder the view of theſe two joints, and then will turn the head into all the different poſitions it is capable of. The head then may be ſeen to move forwards and backwards, on the firſt vertebre as was already ſaid, while the atlas performs the circumgyration upon the ſecond vertebre; the inferior oblique proceſſes of the firſt vertebre ſhuffling eaſily in a circular way on the ſuperior oblique proceſſes of the ſecond, and its body or anterior arch having a rotation on the tooth-like proceſs, by which the perpendicular ligament that is ſent from the point of the tooth-like proceſs to the occipital bone is twiſted, while the lateral ligaments that fix the proceſſus dentatus to the ſides of the firſt vertebre, and to the os occipitis, are very differently affected; for the one upon the ſide towards which the face is turned by the circumgyration, is much ſhortened and lax, while the oppoſite one is ſtretched and made tenſe, and yielding at laſt no more, prevents the head from turning any further round on this axis. So that theſe lateral ligaments are the proper moderators of the circumgyration of the head here, which muſt be larger or ſmaller, as theſe ligaments are weaker or ſtronger, longer or ſhorter, and more or leſs capable of being ſtretched. Beſides the revolution on this axis, the firſt vertebre can move a ſmall way to either ſide; but is prevented from moving backwards and forwards, by its anterior arch, and by the croſs ligament, which are both cloſely applied to the tooth-like proceſs. Motion forwards here would have been of very bad conſequence, as it would have brought the beginning of the ſpinal marrow upon the point of the tooth-like proceſs.

The rotatory motion of the head is of great uſe to us on many accounts, by allowing us to apply quickly our organ of ſenſes to objects; and the axis of rotation was altogether proper to be at this place; for if it had been at a greater diſtance from the head, the weight of the head, if it had been at any time removed from a perpendicular bearing to the very ſmall moveable joint, and thereby had required a long lever, would have broke the ligaments at every turn inconſiderately performed; or theſe ligaments muſt have been formed much ſtronger than could have been connected to ſuch ſmall bones. Neither could this circular motion be performed on the firſt vertebre without danger, becauſe the immoveable part of the medulla oblongata is ſo near, as, at each large turn the beginning of the ſpinal marrow would have been in danger of being twiſted, and of ſuffering by the compreſſion this would have made on its tender fibrils.

It is neceſſary to obſerve, that the lateral or moderator ligaments confine ſo much the motion of the firſt vertebre upon the ſecond, that, though this joint may ſerve us on ſeveral occaſions, yet we are often obliged to turn our faces farther round than could be done by this joint alone, without the greateſt danger of twiſting the ſpinal marrow too much, and alſo of luxating the oblique proceſſes; therefore in large turns of this kind, the rotation is aſſiſted by all the vertebres of the neck and loins; and if this is not ſufficient, we employ moſt of the joints of the lower extremities. This combination of a great many joints towards the performance of our motions is alſo to be obſerved in ſeveral other parts of the body; notwithſtanding ſuch motions being generally ſaid to be performed by ſome ſingle joint only.

The third vertebre of the neck is by ſome called axis; but this name is applied to it with much leſs reaſon than to the ſecond. This third, and the three below, have nothing particular in their ſtructure; but all their parts come under the general deſcription formerly given, each of them being larger as they deſcend.

The ſeventh vertebre of the neck is near to the form of thoſe of the back, having the upper and lower ſurfaces of its body leſs hollow than the others: the oblique proceſſes are more perpendicular. Neither ſpinal nor tranſverſe proceſſes are forked. This ſeventh and the ſixth vertebre of the neck have the hole in each of their tranſverſe proceſſes more frequently divided by a ſmall croſs bridge, that goes between the cervical vein and artery, than any of the other vertebres.

The twelve dorſal may be diſtinguiſhed from the other vertebres of the ſpine by the following marks.

Their bodies are of a middle ſize, betwixt thoſe of the neck and loins. They are more convex before than either of the other two ſorts; and are flatted laterally by the preſſure of the ribs, which are inſerted into ſmall cavities formed in their ſides. This flatting on their ſides, which makes the figure of theſe vertebres almoſt an half oval, is of good uſe, as it affords a firm articulation to the ribs, allows the trachea arteria to divide at a ſmall angle, and the other large veſſels to run ſecure from the action of the vital organs. Theſe bodies are more concave behind than any of the other two claſſes. Their upper and lower ſurfaces are horizontal.

The cartilages interpoſed between the bodies of theſe vertebres are thinner than in any other of the true vertebres; and contribute to the concavity of the ſpine in the thorax, by being thinneſt at their fore part.

The oblique proceſſes are placed almoſt perpendicular; the upper ones ſlanting but a little forwards, and the lower ones ſlanting as much backwards. They have not as much convexity or concavity as is worth remarking. Between the oblique proceſſes of the oppoſite ſides, ſeveral ſharp proceſſes ſtand out from the upper and lower parts of the plates which join to form the ſpinal proceſs; into theſe ſharp proceſſes ſtrong ligaments are fixed for connecting the vertebres.

The tranſverſe proceſſes of the dorſal vertebres are long, thicker at their ends than in the middle, and turned obliquely backwards; which may be owing to the preſſure of the ribs, the tubercles of which are inſerted into a depreſſion near the end of theſe proceſſes.

The ſpinal proceſſes are long, ſmall pointed, and ſloping downwards and backwards; from their upper and back part a ridge riſes, which is received by a ſmall channel in the fore part of the ſpinal proceſs immediately above, which is here connected to it by a ligament.

The conduit of the ſpinal marrow is here more circular, but corresponding to the ſize of that cord, is ſmaller than in any of the other vertebres, and a larger ſhare of the holes in the bony bridges, for the tranſmiſſion of the nerves, is formed in the vertebre above, than in the one below.

The connection of the dorſal vertebres to the ribs, the thinneſs of their cartilages, the erect ſituation of the oblique proceſſes, the length, ſloping, and connection of the ſpinal proceſſes, all contribute to reſtrain theſe vertebres from much motion, which might diſturb the actions of the heart and lungs; and, in conſequence of the little motion allowed here, the intervertebral cartilages ſooner ſhrivel, by becoming more ſolid: and therefore, the firſt remarkable curvature of the ſpine obſerved, as people advance to old age, is in the leaſt ſtretched vertebres of the back; for old people firſt become round ſhouldered.

The bodies of the four uppermoſt dorſal vertebres deviate from the rule of the vertebres becoming larger as they deſcend; for the firſt of the four is the largeſt, and the other three below gradually become ſmaller, to allow the trachea and large veſſels to divide at ſmaller angles.

The two uppermoſt vertebres of the back, inſtead of being very prominent forwards, are flattened by the action of the muſculi longi colli and recti majores.

The proportional ſize of the two little depreſſions in the body of each vertebre for receiving the heads of the ribs, ſeems to vary in the following manner; the depreſſion on the upper edge of each vertebre decreaſes as far down as the fourth, and after that increaſes.

The tranſverſe proceſſes are longer in each lower vertebre to the ſeventh or eighth, with their ſmooth ſurfaces, for the tubercles of the ribs, facing gradually more downwards; but afterwards as they deſcend they become ſhorter, and the ſmooth ſurfaces are directed more upwards.

The ſpinous proceſſes of the vertebres of the back become gradually longer and more ſlanting from the firſt, as far down as the eighth or ninth vertebre; from which they manifeſtly turn ſhorter and more erect.

The firſt vertebre, beſides an oblong hollow in its lower edge, that aſſiſts in forming the cavity wherein the ſecond rib is received, has the whole cavity for the head of the firſt rib formed in it.

The ſecond has the name of axillary, without any thing particular in its ſtructure.

The eleventh often has the whole cavity for the eleventh rib in its body, and wants the ſmooth ſurface on each tranſverſe proceſs.

The twefth always receives the whole head of the laſt rib, and has no ſmooth ſurface on its tranſverſe proceſſes, which are very ſhort. The ſmooth ſurfaces of its inferior oblique proceſſes face outwards, as the lumbar do. And we may ſay, in general, that the upper vertebres of the back loſe gradually their reſemblance to thoſe of the neck, and the lower ones come nearer to the figure of the lumbar.

The articulation of the vertebres of the back with the ribs, ſhall be more particularly conſidered after the ribs are deſcribed. Only it may be proper now to remark, that the ligaments which ſerve that articulation aſſiſt in connecting the vertebres.

The loweſt order of the true vertebres is the lumbar, which are five bones, that may be diſtinguiſhed from any others by theſe marks: 1ſt, Their bodies, though of a circular form at their fore part, are ſomewhat oblong from one ſide to the other; which may be occaſioned by the preſſure of the large veſſels, the aorta and cava, and of the viſcera. The epiphyſes on their edges are larger, and therefore the upper and lower ſurfaces of their bodies are more concave than in the vertebres of the back. 2dly, The cartilages between theſe vertebres are much the thickeſt of any, and render the ſpines convex within the abdomen, by their greateſt thickneſs being at their fore part. 3dly, The oblique proceſſes are ſtrong and deep; thoſe in oppoſite ſides being almoſt placed in parallel planes; the ſuperior, which are concave, facing inwards, and the convex inferior ones facing outwards: and therefore each of theſe vertebres receives the one above it, and is received by the one below; which is not ſo evident in the other two claſſes already deſcribed. 4thly, Their tranſverſe proceſſes are ſmall, long, and almoſt erect, for allowing large motion to each bone, and ſufficient inſertion to muſcles, and for ſupporting and defending the internal parts. 5thly, Betwixt the roots of the ſuperior oblique and tranverſe proceſſes, a ſmall protuberance may be obſerved, where ſome of the muſcles that raiſe the trunk of the body are inſerted. 6thly, Their ſpinal proceſſes are ſtrong, ſtreight, and horizontal, with broad flat ſides, and a narrow edge above and below; this laſt being depreſſed on each ſide by muſcles; and at the root of theſe edges, we ſee rough ſurfaces for fixing the ligaments. 7thly, The canal for the numerous cords, called cauda equina, into which the ſpinal marrow divides, is rather larger in theſe bones than what contains that marrow in the vertebres of the back. 8thly, The holes for the paſſage of the nerves, are more equally formed out of both the contiguous vertebres than in the other claſſes; the upper one furniſhes however the larger ſhare of each hole.

The thick cartilages between theſe lumbar vertebres, their deep oblique proceſſes, and their erect ſpinal proceſſes, are all fit for allowing large motion; though it is not ſo great as what is performed in the neck; which appears from comparing the arches which the head deſcribes when moving on the neck, or the loins only.

The lumbar vertebres as they deſcend, have their oblique proceſſes at a greater diſtance from each other, and facing more backwards and forwards.

Both tranſverſe and ſpinal proceſſes of the middlemoſt vertebres of the loins are longeſt and thickeſt; in the vertebres above and below they are leſs: ſo that theſe proceſſes of the firſt and fifth, are the leaſt, to prevent their ſtriking on the ribs of the oſſa illium, or their bruiſing the muſcles in the motions of the ſpine.

The epiphyſes round the edges of the bodies of the lumbar vertebres, are moſt raiſed in the two loweſt, which conſequently make them appear hollower in the middle than the others are.

The body of the fifth vertebre is rather thinner than that of the fourth. The ſpinal proceſs of the fifth is ſmaller, and the oblique proceſſes face more backwards and forwards than in any other lumbar vertebre.

After conſidering the ſtructure of the particular vertebres, and their mutual connection, we may obſerve a ſolicitous care taken that they ſhall not be disjoined, but with great difficulty; for beſides being connected by ſtrong ligaments proportioned to the forces which are to be reſiſted, their bodies either enter ſo into each other, as to prevent their being diſplaced any way, as in the vertebres of the neck; or they are propped on all ſides, as thoſe of the back are by the ribs; or their ſurfaces of contact are ſo broad, as to render the ſeparation almoſt impracticable, as in the loins; while the depth and articulation of the oblique proceſſes are exactly proportioned to the quantity of motion which the other parts of the bones allow, or the muſcles can perform: yet, as theſe oblique proceſſes are ſmall, and therefore not capable of ſo ſecure a conjunction as the larger bodies, they may ſooner yield to a disjoining force; but then their diſlocation is not of near ſo bad conſequence as the ſeparation of the bodies would be. For, by the oblique proceſſes being diſlocated, the muſcles, ligaments, and ſpinal marrow are indeed ſtretched; but this marrow muſt be compreſſed, or entirely deſtroyed, when the body of the vertebre is removed out of its place.

The falſe vertebres compoſe the under pyramid of the ſpine. They are diſtinguiſhed from the bones already deſcribed juſtly enough by this epithet of falſe; becauſe though each bone into which they can be divided in young people, reſemble the true vertebre in figure, yet none of them contribute to the motion of the trunk of the body; they being intimately united to each other in adults, except at their lower part, where they are moveable; whence they are commonly divided into two bones, os ſacrum, and coccygis.

The os ſacrum, is ſo called, from being offered in ſacrifice by the antients, or rather becauſe of its largeneſs in reſpect of the other vertebres. This bone is of an irregular triangular ſhape, broad above, narrow before, convex behind, for the advantageous origin of the muſcles that move the ſpine and thigh backwards; and concave behind, for enlarging the cavity of the pelvis. Four tranſverſe lines of a colour different from the reſt of the bones which are ſeen on its fore part, are the marks of diviſion of the five different bones of which it conſiſts in young perſons.

The fore-part of the os ſacrum, analogous to the bodies of the true vertebres, is ſmooth and flat, to allow a larger ſpace for the contained bowels, without any danger of hurting them; or this flat figure may be owing to the equal preſſure of theſe bowels, particularly of the laſt gut. The back-part of it is almoſt ſtreight, without ſo large a cavity as the vertebres have; becauſe the ſpinal marrow, now ſeparated into the cauda equina, is ſmall. The bridges between the bodies and proceſſes of this bone, are much thicker, and in proportion ſhorter, than in the former claſs of bones. The ſtrength of theſe croſs bridges is very remarkable in the three upper bones, and is well proportioned to the incumbent weight of the trunk of the body, which theſe bridges ſuſtain in a tranſverſe, conſequently an unfavourable ſituation, when the body is erect.

There are only two oblique proceſſes of the os ſacrum; one ſtanding out on each ſide from the upper part of the firſt bone. Their plain erect ſurfaces face backwards, and are articulated with the inferior oblique proceſſes of the laſt vertebre of the loins, to which each of theſe proceſſes is connected by a ſtrong ligament, which riſes from a ſcabrous cavity round their roots, where mucilaginous glands are alſo lodged. Inſtead of the other oblique proceſſes of this bone, four rough tubercles are to be ſeen on each ſide of its ſurface behind, from which the muſculus ſacer has its origin.

The tranſverſe proceſſes here are all grown together into one large ſtrong oblong proceſs on each ſide; which ſo far as it anſwers to the firſt three bones, is very thick, and divided into two irregular cavities, by a long perpendicular ridge. The foremoſt of the two cavities has commonly a thin cartilaginous ſkin covering it in the recent ſubject, and is adapted to the unequal protuberance of the os ilium, and a ſtrong ligament connects the circumference of theſe ſurfaces of the two bones. The cavity behind is divided by a tranſverſe ridge into two, where ſtrong ligamentous ſtrings that go from this bone to the os ilium with a cellular ſubſtance containing mucus, are lodged.

The tranſverſe proceſſes of the two laſt bones of the os ſacrum are much ſmaller than the former. At their back part near their edge, a knob and oblong flat ſurface give riſe to two ſtrong ligaments which are extended to the os iſchium; and are therefore called ſacro-ſciatic.

The ſpinal proceſſes of the three uppermoſt bones of the os ſacrum appear ſhort, ſharp, and almoſt erect, while the two lower ones are open behind: and ſometimes a little knob is to be ſeen on the fourth, though generally it is bifurcated, without the two legs meeting into a ſpine; in which condition alſo the firſt is often to be ſeen; and ſometimes they never meet, but leave a ſinus, or rather foſſa, inſtead of a canal, as Verveyhen and Le Sue have remarked. The muſculus latiſſimus and longiſſimus dorſi, ſacro-lumbaris, and glutaeus maximus have part of their origins from theſe ſpinal proceſſes.

The canal between the bodies and proceſſes of this bone, for the cauda equina, is triangular; and becomes ſmaller as it deſcends, as the cauda alſo does. Below the third bone, this paſſage is a more complete bony canal, but is open behind; and is only there defended by a ſtrong ligamentous membrane ſtretched over it, which, with the muſcles that cover it, and are very prominent on each ſide, is a ſufficient defence for the bundle of nerves within.

At the root of each oblique proceſs of this bone, the notch is conſpicuous, by which and ſuch another in the laſt vertebre of the loins, the paſſage is left for the twenty-fourth ſpinal nerve; and in viewing the os ſacrum, either before or behind, four large holes appear on each ſide, in much the ſame height, as where the marks of the union of its ſeveral bones remain. Some of the largeſt nerves of the body paſs through the anterior holes; and ſuperficial grooves, running outwards from them in different directions, ſhew the courſe of theſe nerves. From the intervals of theſe grooves, the pyriform muſcle chiefly ariſes. The holes in the back part of the bone are covered by membranes, which allow ſmall nerves to paſs through them. The two uppermoſt of theſe holes, eſpecially on the fore-ſide, are the largeſt; and as the bones deſcend, the holes turn ſmaller. Sometimes a notch is only formed at the lower part on each ſide of this bone; and in other ſubjects there is a hole common to it and the os coccygis, through which the twenty-ninth pair of ſpinal nerves paſſes; and frequently a bony bridge is formed on the back part of each ſide by a proceſs ſent up from the back part of the os coccygis, and joined to the little knobs which the laſt bone of the os ſacrum has inſtead of a ſpinal proceſs. Under this bridge or jugum, the twenty-ninth pair of ſpinal nerves runs in its courſe to the common holes juſt now deſcribed.

The upper part of the body of the firſt bone reſembles the vertebres of the loins; but the ſmall fifth bone is oblong tranſverſely, and hollow in the middle of its lower ſurface.

The ſubſtance of the os ſacrum is very ſpongy, without any conſiderable ſolid external plates, and is lighter proportionally to its bulk, than any other bone in the body; but is ſecured from injuries by the thick muſcles that cover it behind, and by the ſtrong ligamentous membranes that cloſely adhere to it. As this is one of the moſt remarkable inſtances of this ſort of defence afforded a ſoft weak bone, we may make the general obſervation, that, wherever we meet with ſuch a bone, one or other, or both theſe defences are made uſe of, the firſt to ward off injuries; and the ſecond to keep the ſubſtance of the bone from yielding too eaſily.

This bone is articulated above to the laſt vertebre of the loins, in the manner that the lumbar vertebres are joined; and therefore the ſame motions may be performed here. The articulation of the lower part of the os ſacrum to the os coccygis, ſeems well enough adapted for allowing conſiderable motion to this laſt bone, was it not ſo much confined by ligaments. Laterally, the os ſacrum is joined to the oſſa ilium by an immoveable ſynchondroſis, or what almoſt deſerves the name of a ſuture; for the cartilaginous cruſt on the ſurface of the bones is very thin, and both their ſurfaces are ſo ſcabrous and unequal, as to be indented into each other, which makes ſuch a ſtrong connection, that great force is required to ſeparate them, after all the muſcles and ligaments are cut. Frequently the two bones grow together in old ſubjects.

The uſes of the os ſacrum are, to ſerve as the common baſe and ſupport of the trunk of the body, to guard the nerves proceeding from the end of the ſpinal marrow, to defend the back part of the pelvis, and to afford ſufficient origin to the muſcles which move the trunk and thigh.

The bones that compoſe the os ſacrum of infants, have their bodies ſeparated from each other by a thick cartilage; and, in the ſame manner as the true vertebres, each of them conſiſts of a body and two lateral plates, connected together by cartilages; the ends of the plates ſeldom being contiguous behind.

The os coccygis, or rump bone, is that triangular chain of bones depending from the os ſacrum; each bone becoming ſmaller as they deſcend, till the laſt ends almoſt in a point. The os coccygis is convex behind, and concave before: from which crooked pyramidal figure, which was thought to reſemble a cuckow's beak, it has got its name.

This bone conſiſts of four pieces in people of middle age. In children very near the whole of it is cartilage; in old ſubjects, all the bones are united, and become frequently one continued bone with the os ſacrum.

The higheſt of the four bones is the largeſt, with ſhoulders extended farther to each ſide than the end of the os ſacrum; which enlargement ſhould, in my opinion, ſerve as a diſtinguiſhing mark, to fix the limits of either bone; and therefore ſhould take away all diſpute about reckoning the number of bones, of which one or other of theſe two parts of the falſe vertebres, is compoſed; which diſpute muſt ſtill be kept up, ſo long as the numbering five or ſix bones in the os ſacrum depends upon the uncertain accident of this broad ſhouldered little bone being united to or ſeparated from it. The upper ſurface of this bone is a little hollow. From the back of that bulbous part called its ſhoulders, a proceſs often riſes upon each ſide, to join with the bifurcated ſpine of the fourth and fifth bones of the os ſacrum, to form the bony bridge mentioned in the deſcription of the os ſacrum. Sometimes theſe ſhoulders are joined to the ſides of the fifth bone of the os ſacrum, to form the hole on each ſide common to theſe two bones, for the paſſage of the twenty-ninth pair of ſpinal nerves. Immediately below the ſhoulders of the os coccygis, a notch may be remarked on each ſide, where the thirtieth pair of the ſpinal nerves paſſes. The lower end of this bone is formed into a ſmall head, which very often is hollow in the middle.

The three lower bones gradually become ſmaller, and are ſpongy; but are ſtrengthened by a ſtrong ligament which covers and connects them. Their ends by which they are articulated, are formed in the ſame manner as thoſe of the firſt bone are.

Between each of theſe four bones of young ſubjects a cartilage is interpoſed; therefore their articulation is analogous to that of the bodies of the vertebres of the neck: for, as has been above remarked, the lower end of the os ſacrum, and of each of the three ſuperior bones of the os coccygis, has a ſmall depreſſion in the middle; and the upper part of all the bones of the os coccygis is a little concave, and conſequently the interpoſed cartilages are thickeſt in the middle, to fill up both cavities; by which they connect the bone more firmly. When the cartilages oſſify, the upper end of each bone is formed into a cavity, exactly adapted to the protuberant lower end of the bone immediately above. From this ſort of articulation, it is evident, that, unleſs when theſe bones grow together, all of them are capable of motion; of which the firſt and ſecond, eſpecially this laſt, enjoys the largeſt ſhare.

The lower end of the fourth bone terminates in a rough point, to which a cartilage is appended.

To the ſides of theſe bones of the os coccygis, the coccygæi muſcles, and part of the levatores ani, and of the glutæi maximi, are fixed; as deſcribed by Douglas, and depicted in the tables of Euſtachius.

The ſubſtance of theſe bones is very ſpongy, and in children cartilaginous; there being only a part of the firſt bone oſſified in a new-born infant. Since therefore the inteſtinum rectum of children is not ſo firmly ſupported as it is in adults, Spigelius and Pauw think this may be one reaſon why they are more ſubject to a procidentia ani, than old people.

From the deſcription of this bone, we ſee how little it reſembles the vertebres; ſince it ſeldom has proceſſes, never has any cavity for the ſpinal marrow, nor holes for the paſſage of nerves. Its connection hinders it to be moved to either ſide; and its motion backwards and forwards is much confined: yet as its ligaments can be ſtretched by a conſiderable force, it is a great advantage in the excretion of the alvine fæces, and much more in child-bearing, that this bone ſhould remain moveable; and the management of it, in delivering women, may be of great benefit to them, as Pauw and Deventer have juſtly obſerved. The mobility of the os coccygis diminiſhing as people advance in age, eſpecially when its ligaments and cartilages have not been kept flexible by being ſtretched, is probably one reaſon why the women, who are old maids before they marry, have generally hard labours.

The os coccygis ſerves to ſuſtain the inteſtinum rectum; and in order to perform this office the more effectually, it is made to turn with a curve forwards; by which alſo the bone itſelf, as well as the muſcles and teguments, is preſerved from any injury.

The ſecond part of the trunk of the ſkeleton, the pelvis, is the cylindrical cavity at the lower part of the abdomen, formed by the os ſacrum, os coccygis, and oſſa innominata; which laſt therefore fall now in courſe to be examined.

The oſſa innominata are two large broad bones which form the fore-part and ſides of the pelvis, and the lower part of the ſides of the abdomen. In children, each of theſe bones is evidently divided into three; which are afterwards ſo intimately united, that ſcarce the leaſt part of their former ſeparation remains. This notwithſtanding, they are deſcribed as conſiſting each of three bones, to wit, the os ilium, iſchium, and pubis; which I ſhall firſt deſcribe ſeparately, and then ſhall conſider what is common to any two of them, or to all the three.

The OS ILIUM, or haunch-bone, is ſituated the higheſt of the three, and reaches as far down as one third of the great cavity, into which the head of the thigh bone is received.

The external ſide of this bone is unequally convex, and is called its dorſum. The internal concave ſurface is by ſome (but improperly) named its coſta. The ſemicircular edge at the higheſt part of this bone, which is tipped with a cartilage in the recent ſubject, is named the ſpine, into which the external or deſcending oblique muſcle of the abdomen is inſerted; and from it the internal aſcending oblique, and the tranſverſe muſcles of the belly, with the glutæus maximus, quadratus lumborum, and latiſſimus dorſi, have their origin. Winſlow and ſome others are of opinion, that it is only the tendinous cruſt

of

of all theſe muſcles, and not a cartilage, as commonly alledged, that covers this bony edge. The ends of the ſpine are more prominent than the ſurface of the bone below them; therefore are reckoned proceſſes. From the anterior ſpinal proceſs, the ſartorius and faſcialis muſcles have their riſe; and the outer end of the doubled tendon of the external oblique muſcle of the abdomen, commonly called Fallopius's or Poupart's ligament, is fixed to it. The inſide of the poſterior proceſs, and of part of the ſpine forward from that, is made flat and rough, where the ſacro-lumbalis and longiſſimus dorſi riſe; and to its outſide ligaments, extended to the os ſacrum and tranſverſe proceſſes of the fifth and fourth vertebres of the loins, are fixed, as remarked by Weitbrecht. Below the anterior ſpinal proceſs another protuberance ſtands out, which, by its ſituation, Baker, in his Oſteology, has diſtinguiſhed from the former, by adding the epithet of inferior, where the muſculus rectus tibiæ has its origin. Betwixt theſe two anterior proceſſes the bone is hollowed where the beginning of the ſartorius muſcle is lodged. Below the poſterior ſpinal proceſs, a ſecond protuberance of the edge of this bone is in like manner obſervable, which is cloſely applied to the os ſacrum. Under this laſt proceſs a conſiderable large niche is obſervable in the os ilium; between the ſides of which, and the ſtrong ligament that is ſtretched over from the os ſacrum to the ſharp-pointed proceſs of the os iſchium of the recent ſubject, a large hole is formed, through which the muſculus pyriformis, the great ſciatic nerve, and the poſterior crural veſſels paſs, and are protected from compreſſion.

The external broad ſide, or dorſum of the os ilium, is a little hollow towards the fore-part; farther back it is as much raiſed; then is conſiderably concave; and, laſtly, it is convex. Theſe inequalities are occaſioned by the actions of the muſcles that are ſituated on this ſurface. From behind the uppermoſt of the two anterior ſpinal proceſſes, in ſuch bones as are ſtrongly marked by the muſcles, a ſemicircular ridge is extended to the hollow paſſage of the ſciatic nerve. Between the ſpine and this ridge the glutæus medius takes its riſe. Immediately from above the loweſt of the anterior ſpinal proceſſes, a ſecond ridge is ſtretched to the niche. Between this and the former ridge, the glutæus minimus has its origin. On the outſide of the poſterior ſpinal proceſſes, the dorſum of the os ilium is flat and rough, where part of the muſculus glutæus maximus and pyriformis riſes. The loweſt part of this bone is the thickeſt, and is formed into a large cavity with high brims, to aſſiſt in compoſing the great acetabulum, which ſhall be conſidered, after all the three bones that conſtitute the os innominatum are deſcribed.

The internal ſurface of the os ilium is concave in its broadeſt forepart, where the internal iliac muſcle has its origin, and ſome ſhare of the inteſtinum ilium and colon is lodged. From this large hollow, a ſmall ſinuoſity is continued obliquely forwards, at the inſide of the anterior inferior ſpinal proceſs, where part of the pſoas and iliacus muſcles, with the crural veſſels and nerves paſs. The large concavity is bounded below by a ſharp ridge, which runs from behind forwards;

wards; and being continued with ſuch another ridge of the os pubis, forms a line of partition between the abdomen and pelvis. Into this ridge the broad tendon of the pſoas parvus is inſerted.

All the internal ſurface of the os ilium, behind this ridge, is very unequal; for the upper part is flat, but ſpongy, where the ſacro-lumbalis and longiſſimus dorſi riſe. Lower down, there is a tranſverſe ridge, from which ligaments go out to the os ſacrum. Immediately below this ridge, the rough unequal cavities and prominences are placed, which are exactly adapted to thoſe deſcribed on the ſide of the os ſacrum. In the ſame manner the upper part of this rough ſurface is porous, for the firmer adheſion of the ligamentous cellular ſubſtance; while the lower part is more ſolid, and covered with a thin cartilaginous ſkin, for its immoveable articulation with the os ſacrum. From all the circumference of this large unequal ſurface, ligaments are extended to the os ſacrum, to ſecure more firmly the conjunction of theſe bones.

The paſſages of the medullary veſſels are very conſpicuous, both in the dorſum and coſta of many oſſa ilium; but in others they are inconſiderable.

The poſterior and lower parts of theſe bones are thick; but they are generally exceeding thin and compact at their middle, where they are expoſed to the actions of the muſculi glutæi and iliacus internus, and to the preſſure of the bowels contained in the belly. The ſubſtance of the oſſa ilium is moſtly cellular, except a thin external table.

In a new-born child, the ſpine of the os ilium is cartilaginous, and is afterwards joined to the bone in form of an epiphyſis. The large lower end of this bone is not as yet completely oſſified.

The os ISCHIUM, or hip bone, is of a middle bulk between the two other parts of the os innominatum; is ſituated the loweſt of the three, and is of a very irregular figure. Its extent might be marked by an horizontal line drawn near through the middle of the acetabulum; for the upper bulbous part of this bone forms ſomething leſs than the lower half of that great cavity, and the ſmall leg of it riſes to much the ſame height on the other ſide of the great hole common to this bone and the os pubis.

From the upper thick part of the os iſchium, a ſharp proceſs, called by ſome ſpinous, ſtands out backwards, from which chiefly the muſculus coccygæus and ſuperior gemellus, and part of the levator ani riſe, and the anterior or external ſacro-ſciatic ligament is fixed to it. Between the upper part of this ligament and the bones, it was formerly obſerved, that the pyriform muſcle, the poſterior crural veſſels, and the ſciatic nerves, paſs out of the pelvis. Immediately before this proceſs, a ſinuoſity is formed for the tendons of the muſculus obturator internus. In a recent ſubject, this part of the bone, which ſerves as a pulley on which the obturator muſcle plays, is covered with a ligamentous cartilage, that, by two or three ſmall ridges, points out the interſtices of the fibres in the tendon of this muſcle. The outer ſurface of the bone, at the root of this ſpinous proceſs, is made hollow by the pyriformis, or iliacus externus muſcle.

Below the ſinuoſity for the obturator muſcle, is the great knob or tuberoſity, covered with cartilage or tendon, deſcribed by Winſlow. The upper part of the tuberoſity gives riſe to the inferior gemellus muſcle. To a ridge at the inſide of this, the external or poſterior ſacro-ſciatic ligament is ſo fixed, that between it, the internal ligament, and the ſinuoſity of the os iſchium, a paſſage is left for the internal obturator muſcle.

The upper thick ſmooth part of the tuberoſity, called by ſome its dorſum, has two oblique impreſſions on it. The inner one gives origin to the long head of the biceps flexor tibiæ and ſemi-nervoſus muſcles, and the ſemi-membranoſus riſes from the exterior one, which reaches higher and nearer the acetabulum than the other. The lower, thinner, more ſcabrous part of the knob which bends forwards, is alſo marked with two flat ſurfaces, whereof the internal is what we lean upon when ſitting, and the external gives riſe to the largeſt head of the triceps adductor femoris. Between the external margin of the tuberoſity, and the great hole of the os innominatum, there is frequently an obtuſe ridge extended down from the acetabulum, which gives origin to the quadratus femoris. As the tuberoſity advances forwards, it becomes ſmaller, and is rough, for the origin of the muſculus tranſverſalis and erector penis. The ſmall leg of it, which mounts upwards to the joint of the os pubis, is rough and prominent at its edge, where the two lower heads of the triceps, or quadriceps adductor femoris take their riſe.

The upper and back part of the os iſchium is broad and thick; but its lower and fore-part is narrower and thinner. Its ſubſtance is of the ſtructure common to broad bones.

The os ilium and pubis of the ſame ſide, are the only bones which are contiguous to the os iſchium.

The part of the os iſchium which forms the acetabulum, the ſpinous proceſs, the great tuberoſity, and the recurved leg, are all cartilaginous at birth. The tuberoſity, with part of the leg or proceſs above it, becomes an epiphyſis before this bone is fully formed.

The os pubis, or ſhare-bone, is the leaſt of the three parts of the os innominatum, and is placed at the upper fore-part of it. The thick largeſt part of this bone is employed in forming the acetabulum; from which becoming much ſmaller, it is ſtretched inwards to its fellow of the other ſide, where again it grows larger, and ſends a ſmall branch downwards, to join the end of the ſmall leg of the os iſchium. The upper fore-part of each os pubis is tuberous and rough, where the muſculus rectus and pyramidalis are inſerted. From this a ridge is extended along the upper edge of the bone, in a continued line with ſuch another of the os ilium, which divides the abdomen and pelvis. The ligament of Fallopius is fixed to the internal end of this ridge, and the ſmooth hollow below it is made by the pſoas and iliacus internus muſcles paſſing with the anterior crural veſſels and nerves behind the ligament. Some way below the former ridge, another is extended from the tuberous part of the os pubis downwards and outwards towards the acetabulum; between theſe two ridges the bone is hollow and ſmooth, for lodging the head of the pectineus muſcle. Immediately below, where the lower ridge is to take the turn downwards, a winding niche is made, which is comprehended in the great foramen of a ſkeleton, but is formed into a hole by a ſubtended ligament in the recent ſubject, for the paſſage of the poſterior crural nerve, an artery, and a vein. The internal end of the os pubis is rough and unequal, for the firmer adheſion of the thick ligamentous cartilage that connects it to its fellow of the other ſide. The proceſs which goes down from that to the os iſchium, is broad and rough before, where the gracilis and upper heads of the triceps, or rather quadriceps adductor femoris have their origin.

The ſubſtance of the os pubis is the ſame as of other broad bones; only a part of the larger end of this bone is oſſified, and the whole leg is cartilaginous in a child born at the full time.

Betwixt the os iſchium and pubis a very large irregular hole is left, which, from its reſemblance to a door or ſhield, has been called thyroides. This hole is all, except the niche for the poſterior crural nerve, filled up in a recent ſubject with a ſtrong ligamentous membrane, that adheres very firmly to its circumference.

From this membrane chiefly the two obturator muſcles, external and internal, take their riſe. The great deſign of this hole, beſides rendering the bone lighter, is to allow a ſtrong origin to the obturator muſcles, and ſufficient ſpace for lodging their bellies, that there may be no danger of diſturbing the functions of the contained viſcera of the pelvis by the actions of the internal, nor of the external being bruiſed by the thigh bone, eſpecially by its leſſer trochanter, in the motions of the thigh inwards; both which inconveniences muſt have happened, had the oſſa innominata been complete here, and of ſufficient thickneſs and ſtrength to ſerve as the fixed point of theſe muſcles. The bowels ſometimes make their way through the opening for the veſſels, at the upper part of this thyroid hole, and this cauſes a hernia in this place, an inſtance whereof is recorded in the Memoirs of the Royal Academy of Surgery at Paris, Vol. I. p. 709.

In the external ſurface of the oſſa innominata, near the outſide of the great hole, a large deep cavity is formed by all the three bones conjunctly: for the os pubis conſtitutes about one fifth; the os ilium makes ſomething leſs than two-fifths. The brims of this cavity are very high, and are ſtill much more enlarged by the ligamentous cartilage, with which they are tipped in a recent ſubject. From this form of the cavity it has been called acetabulum; and for a diſtinguiſhing character, the name of the bone that conſtitutes the largeſt ſhare of it is added; therefore acetabulum oſſis iſchii is the name this cavity commonly bears. Round the baſe of the ſupercilia the bone is rough and unequal, where the capſular ligament of the articulation is fixed. The brims at the upper and back part of the acetabulum are much larger and higher than any where elſe; which is very neceſſary to prevent the head of the femur from ſlipping out of its cavity at this place, where the whole weight of the body bears upon it, and conſequently would otherwiſe be conſtantly in danger of thruſting it out. As theſe brims are extended downwards and forwards, they become leſs; and at their internal lower part a breach is made in them; from the one ſide of which to the other, a ligament is placed in the recent ſubject, under which a large hole is left, which contains a fatty cellular ſubſtance and veſſels. The reaſon of which appearance has afforded matter of debate. But it ſeems evidently contrived for allowing a larger motion to the thigh inwards; for if the bony brims had been here continued, the neck of the thigh bone muſt have ſtruck upon them when the thighs were brought acroſs each other, which, in a large ſtrong motion this way, would have endangered the neck of the one bone, or brim of the other: then the veſſels which are diſtributed to the joint may ſafely enter at the ſinuoſity in the bottom of the breach; which being however larger than is neceſſary for that purpoſe, allows the large mucilaginous gland of the joint to eſcape below the ligaments, when the head of the thigh bone is in hazard of preſſing too much upon it in the motions of the thigh outwards, as remarked by Petit, in the memoirs of the royal academy of Sciences, 1722. Beſides this difference in the height of the brims, the acetabulum is otherwiſe unequal; for the lower internal part of it is depreſſed below the cartilaginous ſurface of the upper part of this particular depreſſion, where it is deepeſt, and of a ſemilunar form, the ligament of the thigh bone, commonly (though improperly) called the round one, is inſerted; while in its more ſuperficial lower part the large mucilaginous gland of this joint is lodged. The largeſt ſhare of this ſeparate depreſſion is formed in the os iſchium.

From what has been ſaid of the condition of the three bones compoſing this acetabulum in new-born children, it muſt be evident, that a conſiderable part of this cavity is cartilaginous in them.

The oſſa innominata are joined at their back part to each ſide of the os ſacrum by a ſort of ſuture, with a very thin intervening cartilage, which ſerves as ſo much glue to cement theſe bones together; and ſtrong ligaments go from the circumference of this unequal ſurface, to connect them more firmly. The oſſa innominata are connected together at their fore-part by the ligamentous cartilage interpoſed between the two oſſa pubis. Theſe bones can therefore have no motion in a natural ſtate, except what is common to the trunk of the body, or to the os ſacrum. But it has been diſputed, whether or not they looſen ſo much from each other, and from the os ſacrum, in child-birth, by the flow of mucus to the pelvis, and by the throws of the labour, as that the oſſa pubis recede from each other, and thereby allow the paſſage between the bones to be enlarged. Numerous obſervations ſhew, that this relaxation ſometimes happens: but Hildanus, Dionis, and Morgagni, who had frequent opportunities of diſſecting the bodies of women who died immediately after being delivered of children, teach us not to regard this as the common effect of child-birth; for they found ſuch a relaxation in very few of the bodies which they examined.

Conſidering what great weight is ſupported in our erect poſture, by the articulation of the oſſa innominata with the os ſacrum, there is great reaſon to think, that if the conglutinated ſurfaces of theſe bones were once ſeparated, without which the oſſa pubis cannot ſhuffle on each other, the ligaments would be violently ſtretched, if not torn; from whence many diſorders would ariſe, as Ludovicus takes notice in the firſt volume of the German Ephemerides.

Each os innominatum affords a ſocket (the acetabulum) for the thigh bones to move in, and the trunk of the body rolls here ſo much on the heads of the thigh bones, as to allow the moſt conſpicuous motions of the trunk, which are commonly thought to be performed by the bones of the ſpine. This articulation is to be more fully deſcribed after the oſſa femoris are examined.

The pelvis then has a large open above, where it is continued with the abdomen, is ſtrongly fenced by bones on the ſides, back, and forepart, and appears with a wide opening below in the ſkeleton; but in the recent ſubject, a conſiderable part of the opening is filled by the ſacro-ſciatic ligaments, pyriform, internal obturator, levatores ani, gemini and coccygei muſcles, which ſupport and protect the contained parts better than bones could have done, ſo that ſpace is only left at the loweſt part of it for the large excretories, the veſica urinaria, inteſtinum rectum, and, in females, the uterus, to diſcharge themſelves.

The THORAX, or cheſt, which is the only part of the trunk of the body which we have not yet deſcribed, reaches from below the neck to the belly, and by means of the bones that guard it, is formed into a large cavity, the figure of which is ſomewhat conoidal; but its upper ſmaller end is not finiſhed, being left open for the paſſage of the windpipe, gullet, and large blood veſſels; and its lower part, or baſe, has no bones, and is ſhorter before than behind: ſo that, to carry on our compariſon, it appears like an oblique ſection of a cone. Beſides which we ought alſo to remark with Albinus, that the lower part of this cavity is narrower than ſome way above; and that the middle of its back part is conſiderably diminiſhed by the bones ſtanding forewards into it.

The bones which form the thorax, are the twelve dorſal vertebres behind, the ribs on the ſides, and the ſternum before.

The vertebres have already been deſcribed as part of the ſpine.

The RIBS or COSTAE (as if they were guards to the principal organs of the animal machine, the heart and lungs) are the long crooked bones placed at the ſide of the cheſt in an oblique direction downwards in reſpect of the back-bone. Their number is generally twelve on each ſide, though frequently eleven or thirteen have been found, as Riolan, Marchetti, Cowper, and Morgagni teſtify. Le Sue remarks, that ſometimes the ribs are found preternaturally conjoined or divided.

The ribs are all concave internally; where they are alſo made ſmooth by the action of the contained parts, which, on this account, are in no danger of being hurt by them; and they are convex externally, that they might reſiſt that part of the preſſure of the atmoſphere, which is not ballanced by the air within the lungs during inſpiration. The ends of the ribs next the vertebres are rounder than they are after theſe bones have advanced forewards, when they become flatter and broader, and have an upper and lower edge, each of which is made rough by the action of the intercoſtal muſcles inſerted into them. The muſcles being all of nearly equal force, and equally ſtretched in the interſtices of the ribs, prevent the broken ends of theſe bones in a fracture from being removed far out of their natural place, to interrupt the motion of the vital organs. The upper edge of the ribs is more obtuſe and rounder than the lower, which is depreſſed on its internal ſide by a long foſſa, for lodging the intercoſtal veſſels and nerves ; on each ſide of which there is a ridge, to which the intercoſtal muſcles are fixed. The foſſa is not obſervable, however, at either end of the ribs, for, at the poſterior or root, the veſſels have not yet reached the ribs, and, at the fore end, they are ſplit away into branches, to ſerve the parts between the ribs ; which plainly teaches ſurgeons one reaſon of the greater ſafety of performing the operation of the empyema towards the ſides of the thorax, than either near the back or the breaſt.

At the poſterior end of each rib a little head is formed, which is divided by a middle ridge into two plain or hollow ſurfaces, the loweſt of which is the broadeſt and deepeſt in moſt of them. The two plains are joined to the bodies of two different vertebres, and the ridge forces itſelf into the intervening cartilage.

A little way from this head we find, on the external ſurface, a ſmall cavity, where mucilaginous glands are lodged ; and round the head the bone appears ſpongy, where the capſular ligament of the articulation is fixed. Immediately beyond this a flatted tubercle riſes, with a ſmall cavity at, and roughneſs about its root, for the articulation of the rib with the tranſverſe proceſs of the loweſt of the two vertebres, with the bodies of which the head of the rib is joined. Advancing farther on this external ſurface, we obſerve in moſt of the ribs another ſmaller tubercle, into which ligaments which connect the ribs to each other, and to the tranſverſe proceſſes of the vertebres, and portions of the longiſſimus dorſi, are inſerted. Beyond this the ribs are made flat by the ſacro-lumbalis muſcle, which is inſerted into part of this flat ſurface fartheſt from the ſpine, where each rib makes a conſiderable curve, called by ſome its angle.

Then the rib begins to turn broad, and continues ſo to its anterior end, which is hollow and ſpongy, for the reception of, and firm coalition with the cartilage that runs thence to be inſerted into the ſternum, or to be joined with ſome other cartilage. In adults, generally the cavity of this end of the ribs, is ſmooth and poliſhed on its ſurface, by which the articulation of the cartilage with it has the appearance of being deſigned for motion, but it has none.

The ſubſtance of the ribs is ſpongy, cellular, and only covered with a very thin external lamellated ſurface, which increaſes in thickneſs and ſtrength as it approaches the vertebres.

To the fore-end of each rib, a long, broad, and ſtrong cartilage is fixed, and reaches thence to the ſternum, or is joined to the cartilage of the next rib. This courſe, however, is not in a ſtreight line with the rib, for generally the cartilages make a conſiderable curve, the concave part of which is upwards; therefore at their inſertion, into the ſternum, they make an obtuſe angle above, and an acute one below. Theſe cartilages are of ſuch a length, as never to allow the ribs to come to a right angle with the ſpines, but they keep them ſituated ſo obliquely, as to make an angle very conſiderably obtuſe above, till a force exceeding the elaſticity of the cartilages is applied. Theſe cartilages, as all others, are firmer, and harder internally, than they are on their external ſurface; and ſometimes in old people, all their middle ſubſtances become bony, while other cartilaginous lamellæ appear externally, according to Veſalius. The oſſification, however, begins frequently at the external ſurface. The greateſt alternate motions of the cartilages being made at their great curvature, that part remains frequently cartilaginous, after all the reſt is oſſified, as Havers obſerves in his Oſteology.

The ribs then are articulated at each end, of which the one behind is doubly joined to the vertebres; for the head is received into the cavities of two bodies of the vertebres, and the larger tubercle is received into the depreſſion in the tranſverſe proceſs of the lower vertebre. When a perſon examines the double articulation, he muſt immediately ſee, that no other motion can here be allowed than upwards and downwards, ſince the tranſverſe proceſs hinders the rib to be thruſt back; the reſiſtance on the other ſide of the ſternum prevents the ribs coming forward, and each of the two joints, with the other parts attached, oppoſe its turning round. But then Winſlow ſays it is likewiſe as evident, that even the motion upwards and downwards can be but ſmall in any one rib at the articulation itſelf. But as the ribs advance forwards, the diſtance from their center of motion increaſing, the motion muſt be larger; and it would be very conſpicuous at their anterior ends, were not they reſiſted there by the cartilages, which yield ſo little, that the principal motion is performed by the middle part of the ribs, which turns outwards and upwards, and cauſes the twiſt remarkable in the long ribs, at the place near their fore-end, where they are moſt reſiſted.

Hitherto have been laid down the ſtructure and connection which moſt of the ribs enjoy, as belonging to all of them; but the ſpecialities muſt now be conſidered where any of them differ from the general deſcription given, or from each other.

In viewing the ribs from above downwards, their figure is ſtill ſtreighter; the uppermoſt being the moſt crooked of any. Their obliquity, in reſpect of the ſpine, increaſes as they deſcend; ſo that though their diſtance from each other is very little different at their back part, yet at their fore-ends the diſtances between the lower ones muſt increaſe. In conſequence too of this increaſed obliquity of the lower ribs, each of their cartilages makes a greater curve in its progreſs from the ribs, towards the ſternum; and the tubercles that are articulated to the tranſverſe proceſſes of the vertebres, have their ſmooth ſurfaces gradually facing more upwards. The ribs becoming thus more oblique, while the ſternum advances forewards in its deſcent, makes the diſtance between the ſternum and the anterior end of the lower ribs, greater than between the ſternum and the ribs above; conſequently the cartilages of thoſe ribs that are joined to the breaſt-bone, are longer in the lower than in the higher ones. The cartilages are placed nearer to each other as the ribs deſcend, which occaſions the curvature of the cartilages to be greater.

The length of the ribs increaſes from the firſt and uppermoſt rib as far down as the ſeventh; and from that to the twelfth as gradually diminiſhes. The ſuperior of the two plain, or rather hollow ſurfaces, by which the ribs are articulated to the bodies of the vertebres, gradually increaſes from the firſt to the fourth rib, and is diminiſhed after that in each lower rib. The diſtance of their angles from the heads always increaſes as they deſcend to the ninth, becauſe of the greater breadth of the ſacro-lumbalis muſcle, as Winſlow juſtly remarks.

The ribs are commonly divided into the true and falſe.

The true ribs are the ſeven upper-ones of each ſide, whoſe cartilages are all gradually longer as the ribs deſcend, and are joined to the breaſt-bone; ſo that being preſſed conſtantly between two bones, they are flatted at both ends, and are thicker, harder, and more liable to oſſify than the other cartilages, that are not ſubject to ſo much preſſure. Theſe ribs include the heart and lungs, and therefore are the proper or true cuſtodes of life.

The five inferior ribs are the falſe or baſtard, whoſe cartilages do not reach to the ſternum, and therefore wanting the reſiſtance at their fore-part, they are there pointed; and on this account, having leſs preſſure, their ſubſtance is ſofter. The cartilages of theſe falſe ribs are ſhorter as the ribs deſcend. To all theſe five ribs the circular edge of the diaphragm is connected; and its fibres, inſtead of being ſtretched immediately tranſverſely, and ſo running perpendicular to the ribs, are preſſed ſo as to be often, eſpecially in expiration, parallel to the plain in which the ribs lie. Nay, one may judge by the attachments which theſe fibres have ſo frequently to the ſides of the thorax, a conſiderable way above where their extremities are inſerted into the ribs, and by the ſituation of the viſcera, always to be obſerved in a dead ſubject laid ſupine, that there is conſtantly a large concavity formed on each ſide by the diaphragm within theſe baſtard ribs, in which the ſtomach, liver, ſpleen, &c. are contained; which being reckoned among the viſcera naturalia, have occaſioned the name of baſtard cuſtodes to theſe bones.

Hence in ſimple fractures of the falſe ribs, without fever, Hippocrates and Ambroſe Parè adviſe the ſtomach to be kept moderately filled with food, leſt the pendulous ribs falling inwards, ſhould thereby increaſe the pain, cough, &c. Hence likewiſe we may learn how to judge better of the ſeat of ſeveral diſeaſes, and to perform the operation of the empyema, and ſome others with more ſafety, than by following the common directions.

Laurentius and Paaw inform us, that the eight upper ribs were formerly claſſed into pairs, with particular names to each two, to wit; the crooked, the ſolid, the pectoral, the twiſted: but theſe names are of ſo little uſe, that they are now generally neglected.

The firſt rib of each ſide is ſo ſituated, that the flat ſides are above and below, while one edge is placed inwards, and the other outwards, or nearly ſo; therefore ſufficient ſpace is left above it for the ſubclavian veſſels and muſcle; and the broad concave ſurface is oppoſed to the lungs: but then, in conſequence of this ſituation, the channel for the intercoſtal veſſels is not to be found, and the edges are differently formed from all the other, except the ſecond; the lower one being rounded, and the other ſharp. The head of this rib is not divided into two plain ſurfaces by a middle ridge, becauſe it is only articulated with the firſt vertebre of the thorax. Its cartilage is oſſified in adults, and is united to the ſternum at right angles. Frequently this firſt rib has a ridge riſing near the middle of its poſterior edge, where one of the heads of the ſcalenus muſcle riſes. Farther forward it is flatted, or ſometimes depreſſed by the clavicle.

The fifth, ſixth, and ſeventh, or rather the ſixth, ſeventh, eighth, and ſometimes the fifth, ſixth, ſeventh, eighth, and ninth ribs, have their cartilages at leaſt contiguous; and frequently they are joined to each other by croſs cartilages; and moſt commonly the cartilages of the eighth, ninth, and tenth, are connected to the former and to each other by firm ligaments.

The eleventh, and ſometimes the tenth rib, has no tubercle for its articulation with the tranſverſe proceſs of the vertebre, to which it is only looſely fixed by ligaments. The foſſa in its lower edge is not ſo deep as in the upper ribs, becauſe the veſſels run more towards the interſtice between the ribs. Its fore-end is ſmaller than its body, and its ſhort ſmall cartilage is but looſely connected to the cartilage of the rib above.

The twelfth rib is the ſhorteſt and ſtreighteſt. Its head is only articulated with the laſt vertebre of the thorax, therefore is not divided into two ſurfaces. This rib is not joined to the tranſverſe proceſs of the vertebre, and therefore has no tubercle, being often pulled neceſſarily inwards by the diaphragm, which an articulation with the tranſverſe proceſs would not have allowed. The foſſa is not found at its under edge, becauſe the veſſels run below it. The fore-part of this rib is ſmaller than its middle, and has only a very ſmall-pointed cartilage fixed to it. To its whole internal ſide the diaphragm is connected.

The motions and uſes of the ribs ſhall be more particularly treated of, after the deſcription of the ſternum.

The heads and tubercles of the ribs of a new-born child, have cartilages on them; part of which becomes afterwards thin epiphyſes. The bodies of the ribs encroach gradually after birth upon the cartilages; ſo that the latter are proportionally ſhorter, when compared to the ribs, in adults, than in children.

Here I cannot help remarking the wiſe providence of our Creator, in preſerving us from periſhing as ſoon as we come into the world. The ends of the bones of the limbs remain in a cartilaginous ſtate after birth, and are many years before they are entirely united to the main body of their ſeveral bones; whereas the condyles of the occipital bone, and of the lower jaw, are true original proceſſes, and oſſified before birth, and the heads and tubercles of the ribs are nearly in the ſame condition; and therefore the weight of the large head is firmly ſupported; the actions of ſucking, ſwallowing, reſpiration, &c. which are indiſpenſably neceſſary for us as ſoon as we come into the world, are performed without danger of ſeparating the parts of the bones that are moſt preſſed on in theſe motions: whereas, had theſe proceſſes of the head, jaw, and ribs, been epiphyſes at birth, children muſt have been expoſed to danger of dying by ſuch a ſeparation; the immediate conſequences of which would be the compreſſion of the beginning of the ſpinal marrow, or want of food, or a ſtop put to reſpiration.

The STERNUM, or breaſt-bone, is the broad flat bone, or pile of bones at the fore-part of the thorax. The number of bones which this ſhould be divided into, has occaſioned debates among anatomiſts, who have conſidered it in ſubjects of different ages. In adults of a middle age it is compoſed of three bones, which eaſily ſeparate after the cartilages connecting them are deſtroyed. Frequently the two lower bones are found intimately united; and very often in old people, the ſternum is a continued bony ſubſtance from one end to the other; though we ſtill obſerve two, ſometimes three tranſverſe lines on its ſurface, which are marks of the former diviſions.

When we conſider the ſternum as one bone, we find it broadeſt and thickeſt above, and becoming ſmaller as it deſcends. The internal ſurface of this bone is ſomewhat hollowed for enlarging the thorax; but the convexity on the external ſurface is not ſo conſpicuous, becauſe the ſides are preſſed outwards by the true ribs; the round heads of whoſe cartilages are received in ſeven ſmooth pits formed on each ſide of the ſternum, and are kept firm by ſtrong ligaments, which as Ruyſch remarks, on the external ſurface, have a particular radiated texture. Frequently the cartilaginous fibres thruſt themſelves into the bony ſubſtance of the ſternum, and are joined by a ſort of ſuture. The pits at the upper part of the ſternum are at the greateſt diſtance one from another, and, as they deſcend, are nearer; ſo that the two loweſt are contiguous.

Sylvius obſerves, that the ſubſtance of the ſternum is cellular, with a very thin external plate, eſpecially on its internal ſurface, where we may frequently obſerve a cartilaginous cruſt ſpread over it. On both ſurfaces, however, a ſtrong ligamentous membrane is cloſely braced; and the cells of this bone are ſo ſmall, that a conſiderable quantity of oſſeous fibres muſt be employed in the compoſition of it: whence, with the defence which the muſcles give it, and the moveable ſupport it has from the cartilages, it is ſufficiently ſecured from being broken; for it is ſtrong by its quantity of bone; its parts are kept together by ligaments; and it yields enough to elude conſiderably the violence offered, in the opinion of Senac.

So far may be ſaid of this bone in general; but the three bones, of which, according to the common account, it is compoſed in adults, are to be examined.

The firſt, all agree, is ſomewhat of the figure of a heart, as it is commonly painted; only it does not terminate in a ſharp point. This is the uppermoſt thickeſt part of the ſternum.

The upper middle part of this firſt bone, where it is thickeſt, is hollowed to make place for the trachea arteria; though this cavity is principally formed by the bone being raiſed on each ſide of it, partly by the clavicles thruſting it inwards, and partly by the ſterno-maſtoidei muſcles pulling it upwards. On the outſide of each tubercle there is an oblong cavity, that, in viewing it tranſverſely from before backwards, appears a little convex; into theſe glenæ the ends of the clavicles are received. Immediately below theſe, the ſides of this bone begin to turn thinner, and in each a ſuperficial cavity or a rough ſurface is to be ſeen, where the firſt are received or joined to the ſternum. In the ſide of the under end of this firſt bone, the half of the pit for the ſecond rib on each ſide is formed. The upper part of the ſurface behind is covered with a ſtrong ligament, which ſecures the clavicles; and is afterwards to be more particularly taken notice of.

The ſecond or middle diviſion of this bone, is much longer, narrower, and thinner than the firſt: but, excepting that it is a little narrower above than below, it is nearly equal all over in its dimenſions of breadth or thickneſs. In the ſides of it are complete pits for the third, fourth, fifth, and ſixth ribs, and half of the pits for the ſecond and ſeventh. The lines which are marks of the former diviſion of this bone, being extended from the middle of the pits of one ſide, to the middle of the correſponding pits of the other ſide. Near its middle, an unoſſified part of the bone is ſometimes found, which, freed of the ligamentous membrane or cartilage that fills it, is deſcribed as a hole; and in this place, for the moſt part, we may obſerve a tranſverſe line, which has made authors divide this bone into two. When the cartilage between this and the firſt bone is not oſſified, a manifeſt motion of this upon the firſt may be obſerved in reſpiration, or in raiſing the ſternum, by pulling the ribs upwards, or diſtending the lungs with air, in a recent ſubject.

The third bone is much leſs than the other two, and has only one half of the pit for the ſeventh rib formed in it; wherefore it might be reckoned only an appendix of the ſternum.

In young ſubjects it is always cartilaginous, and is better known by the name of cartilago xiphoides, or enſiformis, than any other, though the antients often called the whole ſternum enſiforme, comparing the two firſt bones to the handle, and this appendix to the blade of a ſword. This third bone is ſeldom of the ſame figure, magnitude, or ſituation, in any two ſubjects: for ſometimes it is a plain triangular bone, with one of the angles below, and perpendicular to the middle of the upper ſide, by which it is connected to the ſecond bone. In other people the point is turned to one ſide, or obliquely forwards or backwards. Frequently, it is all nearly of an equal breadth, and in ſeveral ſubjects it is bifurcated; whence ſome writers give it the name of furcella, or furcula inferior; or elſe it is unoſſified in the middle: in the greateſt number of adults it is oſſified, and tipped with a cartilage; in ſome, one half of it is cartilaginous, and in others it is all in a cartilaginous ſtate. Generally, ſeveral oblique ligaments, fixed at one end to the cartilages of the ribs, and by the other to the outer ſurface of the xiphoid bone, connect it firmly to thoſe cartilages, as Weitbrecht takes notice in his Syndeſmologia.

So many different ways this ſmall bone may be formed, without any inconvenience; but then ſome of theſe poſitions may be ſo directed, as to bring on a great train of ill conſequences, particularly when the lower end is oſſified, and is too much turned outwards or inwards, or when the conjunction of this appendix with the ſecond bone is too weak, as Rolfinc, Paaw, Codronchi, Borrichius, Bonetus, and others have noticed.

The ſternum is joined by cartilages to the ſeven upper ribs, unleſs when the firſt coaleſces with it in an intimate union of ſubſtance; and its unequal cavity on each ſide of its upper end is fitted for the ends of the clavicles.

The ſternum moſt frequently has four round ſmall bones, ſurrounded with cartilages, in children born at the full time: the uppermoſt of theſe, which is the firſt bone, being the largeſt. Two or three other very ſmall bony points are likewiſe to be ſeen in ſeveral children. The number of bones increaſes for ſome years, and then diminiſhes, but uncertainly, till they are at laſt united into thoſe above deſcribed of an adult.

The uſes of this bone are, to afford origin and inſertion to ſeveral muſcles; to ſuſtain the mediaſtinum, to defend the vital organs, the heart and lungs, at the fore part; and laſtly, by ſerving as a moveable fulcrum of the ribs, to aſſiſt conſiderably in reſpiration: which action, ſo far as it depends on the motion of the bones, we are now at liberty to explain.

When the ribs that are connected by their cartilages to the ſternum, or to the cartilages of the true ribs, are acted upon by the intercoſtal muſcles, they muſt all be pulled from the oblique poſition which their cartilages kept them in, nearer to right angles with the vertebres and ſternum, becauſe the firſt or uppermoſt rib is by much the moſt fixed of any; and the cartilages making a reſiſtance to the raiſing the anterior ends of the ribs, their large arched middle parts turn outwards as well as upwards. The ſternum preſſed ſtrongly on both ſides by the cartilages of the ribs, is puſhed forwards, and that at its ſeveral parts, in proportion to the length and motion of its ſupporters, the ribs; that is, moſt at its lower end. The ſternum and the cartilages thus raiſed forwards, muſt draw the diaphragm connected to them; conſequently ſo far ſtretch it, and bring it nearer to a plane. The power that raiſed this bone and the cartilages, fixes them ſufficiently to make them reſiſt the action of the diaphragm, whoſe fibres contract at the ſame time, and thruſt the viſcera of the abdomen downwards. The arched part of the ribs being thus moved outwards, and the diaphragm being brought nearer to a plain ſurface, inſtead of being greatly convex on each ſide within each cavity of the thorax, it is evident how conſiderably the cavity, of which the nine or ten upper ribs form the ſides, muſt be widened, and made deeper and longer. While this is doing in the upper ribs, the lower ones, whoſe cartilages are not joined to the ſternum, or to other cartilages, move very differently, though they conſpire to the ſame intention, the enlargement of the thorax: for having no fixed point to which their anterior ends are faſtened, and the diaphragm being inſerted into it, at the place where it runs pretty ſtreight upwards from its origin at the vertebres, theſe ribs are drawn downwards by this ſtrong muſcle, and by the muſcles of the abdomen, which, at this time, are reſiſting the ſtretching force of the bowels; while the intercoſtal muſcles are pulling them in the contrary direction, to wit, upwards.

The effect therefore of either of theſe powers, which are antagoniſts to each other, is very little, as to moving the ribs either up or down; but the muſcles of the abdomen, puſhed at this time outwards by the viſcera, carry theſe ribs along with them. Thus the thorax is not only allowed to be ſhortened, but is really widened at its lower part, to aſſiſt in making ſufficient ſpace for the due diſtenſion of the lungs.

As ſoon as the action of theſe ſeveral muſcles ceaſes, the elaſtic cartilages, extending themſelves to their natural ſituation, depreſs the upper ribs, and the ſternum ſubſides: the diaphragm is thruſt up by the abdominal viſcera; and the oblique and tranſverſe muſcles of the belly ſerve to draw the inferior ribs inwards at the ſame time. By theſe cauſes, the cavity of the breaſt is diminiſhed in all its dimenſions.

Though the motions above deſcribed of the ribs and ſternum, eſpecially of the latter bone, are ſo ſmall in the mild reſpiration of a healthy perſon, that we can ſcarce obſerve them; yet they are manifeſt, whenever we deſignedly increaſe our reſpiration, or are obliged to do it after exerciſe, and in ſeveral diſeaſes.

Of the SUPERIOR EXTREMITIES.

AUTHORS are much divided in their opinions about the number of bones which each ſuperior extremity ſhould be ſaid to conſiſt of; ſome deſcribing the clavicle and ſcapula as part of it; others claſsing theſe bones with thoſe of the thorax: but ſince ſome quadrupeds have no clavicles, and the human thorax can perform its functions right, when the ſcapula is taken away, whereas it is impoſſible for us to have the right uſe of our arms without theſe bones, they certainly muſt belong to the ſuperior extremities; and therefore we ſhall divide each of them into the ſhoulder, arm, fore-arm, and hand.

The ſhoulder conſiſts of the clavicle and ſcapula.

The

The CLAVICLE, or collar-bone, is the long crooked bone, in figure like an Italic *S*, placed almoſt horizontally between the upper lateral part of the ſternum, and what is commonly called the top of the ſhoulder, which, as a beam, it bears off from the trunk of the body.

The clavicle, as well as other long bones, is larger at its two ends than in the middle. The end next to the ſternum is triangular: the angle behind is conſiderably produced, to form a ſharp ridge, to which the tranſverſe ligament, extended from one clavicle to the other, is fixed. The ſide oppoſite to this, is ſomewhat rounded. The middle of this protuberant end is as irregularly hollowed, as the cavity in the ſternum for receiving it is raiſed; but in a recent ſubject, the irregular concavities of both are ſupplied by a moveable cartilage, which is not only much more cloſely connected every where by ligaments to the circumference of the articulation, than thoſe of the lower jaw are; but grows to the two bones at both its internal and external end; its ſubſtance at the internal end being ſoft, but very ſtrong, and, according to Weitbrecht, reſembling the intervertebral cartilages.

From this internal end, the clavicle, for about two-fifths of its length, is bended obliquely forwards and downwards. On the upper and fore-part of this curvature a ſmall ridge is ſeen, with a plain rough ſurface before it; whence the muſculus ſterno-hyoideus and ſterno-maſtoideus have in part their origin. Near the lower angle, a ſmall plain ſurface has often been remarked by Dionis, where the firſt rib and this bone are contiguous, and, as Weitbrecht aſſerts, are connected by a firm ligament. From this a rough plain ſurface is extended outwards, where the pectoral muſcle has part of its origin. Behind, the bone is made flat and rough by the inſertion of the larger ſhare of the ſubclavian muſcle. After the clavicle begins to be bended backwards, it is round, but ſoon afterwards becomes broad and thin, which ſhape it retains to its external end. Along the external concavity a rough ſinuoſity runs, from which ſome part of the deltoid muſcle takes its riſe. Oppoſite to this, on the convex edge, a ſcabrous ridge gives inſertion to a ſhare of the cucullaris muſcle. The upper ſurface of the clavicle here is flat, but the lower is hollow, for lodging the beginning of the muſculus ſubclavius; and towards its back part a tubercle riſes, to which, and a roughneſs near it, the ſtrong, ſhort, thick ligament, connecting this bone to the coracoid proceſs of the ſcapula, is fixed.

The external end of this bone is horizontally oblong, ſmooth, ſloping at the poſterior ſide, and tipped, in a recent ſubject, with a cartilage, for its articulation with the acromion ſcapulæ. Round this the bone is ſpongy, for the firmer connexion of the ligaments.

The medullary arteries having their direction obliquely outwards, enter the clavicles by one or more ſmall paſſages in the middle of their back part.

The ſubſtance of this bone is the ſame as that of the other round long bones.

The triangular unequal interior end of each clavicle has the cartilage above deſcribed, interpoſed betwixt it and the irregular cavity of the ſternum. The ligaments, which ſurround this articulation to ſecure it, are ſo ſhort and ſtrong, that little motion can be allowed any way; and the ſtrong ligament that is ſtretched acroſs the upper fercula of the ſternum, from the poſterior prominent angle of the one clavicle, to the ſame place of the other clavicle, ſerves to keep each of theſe bones more firmly in their place. By the aſſiſtance, however, of the moveable intervening cartilage, the clavicle can, at this joint, be raiſed or depreſſed, and moved backwards and forwards ſo much, as that the external end, which is at a great diſtance from that axis, enjoys very conſpicuous motions. The articulation of the exterior end of the clavicle ſhall be conſidered after the deſcription of the ſcapula.

The clavicles of infants are not deficient in any of their parts, nor have they any epiphyſes at their extremities joined afterwards to their bodies, as moſt other ſuch long bones have, which preſerves them from being bended too much, and from the danger of any unoſſified parts being ſeparated by the force which pulls the arms forwards.

The uſes of the clavicles are, to keep the ſcapulæ, and conſequently all the ſuperior extremities, from falling in and forward upon the thorax; by which, as in moſt quadrupeds, the motions of the arms would be much confined, and the breaſt made too narrow. The clavicles likewiſe afford origin to ſeveral muſcles, and a defence to large veſſels.

From the ſituation, figure, and uſe of the clavicles, it is evident that they are much expoſed to fractures; that their broken parts muſt generally paſs by each other, and that they are difficultly kept in their place afterwards.

The Scapula, or ſhoulder-blade, is the triangular bone ſituated on the out-ſide of the ribs, with its longeſt ſide, called its baſe, towards the ſpinal proceſſes of the vertebræ, and with the angle at the upper-part of this ſide about three inches, and the lower angle at a greater diſtance from theſe proceſſes. The back part of the ſcapula has nothing but the thin ends of the ſerratus articus major, and ſub-ſcapularis muſcles between it and the ribs; but as this bone advances forwards, its diſtance from the ribs increaſes. The upper or ſhorteſt ſide, called the ſuperior coſta of the ſcapula, is nearly horizontal, and parallel with the ſecond rib. The lower ſide, which is named the inferior coſta, is extended obliquely from the third to the eighth rib. The ſituation of this bone as here deſcribed, is, when people are ſitting or ſtanding in a ſtate of inactivity, and allowing the members to remain in the moſt natural eaſy poſture. The inferior angle of the ſcapula is very acute; the upper one is near to the right angle, and what is called the anterior does not deſerve the name, for the two ſides do not meet to form an angle. The body of this bone is concave towards the ribs, and convex behind, where it has the name of dorſum. Three proceſſes are generally reckoned to proceed from the ſcapula.

The firſt is the large ſpine that ariſes from its convex ſurface behind, and divides it unequally. The ſecond proceſs ſtands out from the fore-part of the upper-ſide, and, from its imaginary reſemblance to a crow's beak, is named coracoid. The third proceſs is the whole thick bulbous fore-part of the bone.

After thus naming the ſeveral uſual conſtituent parts of the ſcapula, the particular deſcription will be more eaſily underſtood.

The baſe, which is tipped with cartilage in a young ſubject, is not all ſtreight; for above the ſpine it runs obliquely forwards to the ſuperior angle, that here it might not be too protuberant backwards, and ſo bruiſe the muſcles and teguments. Into the oblique ſpace the muſculus patientiæ is inſerted. At the root of the ſpine, on the back part of the baſe, a triangular plain ſurface is formed by the preſſure of the lower fibres of the trapezius. Below this, the edge of the ſcapula is ſcabrous and rough, for the inſertion of the ſerratus major articus and rhomboid muſcles.

The back part of the inferior angle is made ſmooth by the latiſſimus dorſi paſſing over it. This muſcle alſo alters the direction of the inferior coſta; ſome way forwards it is of conſiderable thickneſs, is ſlightly hollowed, and made ſmooth behind by the origin of the teres major. As the inferior coſta advances forward, it is of conſiderable thickneſs, is ſlightly hollowed and made ſmooth behind by the teres minor, while it has a foſſa formed in it below by part of the ſub-ſcapularis, and between the two a ridge with a ſmall depreſſion appears, where the longus extenſor cubiti has its origin.

The ſuperior coſta is very thin, and near its fore-part there is a ſemilunar nitch, from one end of which to the other a ligament is ſtretched; and ſometimes the bone is continued to form one, or ſometimes two holes, for the paſſage of the ſcapular blood veſſels and nerves. Immediately behind this ſemilunar cavity, the coraco-hyoid muſcle has its riſe. From the nitch to the termination of the foſſa for the teres minor, the ſcapula is narrower than any where elſe, and ſupports the third proceſs. This part has the name of cervix.

The whole dorſum of the ſcapula is always ſaid to be convex; but by reaſon of the raiſed edges that ſurround it, it is divided into two cavities by the ſpine, which is ſtretched from behind forwards, much nearer to the ſuperior than to the inferior coſta. The cavity about the ſpine is rarely concave where the ſupra-ſpinatus muſcle is lodged; while the ſurface of this bone below the ſpine, on which the infra-ſpinatus muſcle is placed, is convex, except a foſſa that runs at the ſide of the inferior coſta.

The internal, or anterior ſurface of this bone is hollow, except in the part above the ſpine, which is convex. The ſub-ſcapularis muſcle is extended over this ſurface, where it forms ſeveral ridges and intermediate depreſſions, commonly miſtaken for points of the ribs; they point out the interſtices of the bundles of fibres, of which the ſub-ſcapularis muſcles is compoſed.

The ſpine, as deſcribed by Winſlow in the Memoirs of the Royal Academy of Sciences, 1722, riſes ſmall at the baſe of the ſcapula, and be-

becomes higher and broader as it advances forwards. On the ſides it is unequally hollowed and crooked by the actions of the adjacent muſcles. Its ridge is divided into two rough flat ſurfaces: into the upper one the trapezius muſcle is inſerted, and the lower one has part of the deltoid fixed to it. The end of the ſpine, called the acromion, or top of the ſhoulder, is broad and flat, and is ſometimes joined to the ſpine only by a cartilage, as Le Sue in his Oſteology remarks. The anterior edge of the acromion is flat, ſmooth, and covered with a cartilage, for its articulation with the external end of the clavicle; and it is hollowed below, to allow a paſſage to the infra and ſupra-ſpinati muſcles, and free motion to the os humeri.

The coracoid proceſs is crooked, with its point inclining forwards, ſo that a hollow is left at the lower ſide of its root, for the paſſage of the infra-ſcapularis muſcle. The end of this proceſs is marked with three plain ſurfaces. Into the internal, the ſerratus minor anticus is inſerted. From the external, one head of the biceps flexor cubiti riſes; and, from the lower one, the coraco-brachialis has its origin. At the upper part of the root of this proceſs, immediately before the ſemilunar cavity, a ſmooth tubercle appears where a ligament from the clavicle is fixed. From all the external ſide of this coracoid apophyſis a broad ligament goes out, which becomes narrower where it is fixed to the acromion. The ſharp pain, violent inflammation, and tedious cure of contuſions in this part, are probably owing to theſe tendons and ligaments being hurt.

From the neck of the ſcapula the third proceſs is produced. The forepart of this is formed into a glenoid cavity, which is of the ſhape of the longitudinal ſection of an egg, being broad below, and narrow above. Between the brims of this hollow, and the forepart of the root of the ſpine, a large ſinuoſity is left for the tranſmiſſion of the ſupra and infra-ſpinati muſcles; and on the upper part of theſe brims we may remark a ſmooth ſurface, where the ſecond head of the biceps flexor cubiti has its origin. The root of the ſupercilia is rough all round, for the firmer adheſion of the capſular ligament of the articulation, and of the cartilage which is placed on theſe brims, where it is thick, but becomes very thin as it is continued towards the middle of the cavity, which it lines all over.

The medullary veſſels enter the ſcapula near the baſe of the ſpine. The ſubſtance of the ſcapula, as in all other broad flat bones, is cellular, but of an unequal thickneſs, for the neck and third proceſs are thick and ſtrong. The inferior coſta, ſpine, and coracoid proceſs, are of a middle thickneſs; and the body is ſo preſſed by the muſcles, as to become thin, and diaphanous.

The ſcapula and clavicle are joined by plain ſurfaces, tipped with cartilage, by which neither bone is allowed any conſiderable motion, being tightly tied down by the common capſular ligament, and by a very ſtrong one which proceeds from the coracoid proceſs, but divides into two before it is fixed into the clavicle, with ſuch a direction, as either can allow this bone to have a ſmall rotation, in which its poſterior edge turns more backwards, while the anterior one riſes farther forwards; or it can yield to the forepart of the ſcapula moving downwards, while the back part of it is drawn upwards; in both which caſes the oblong, ſmooth, articulated ſurfaces of the clavicle and ſcapula are not in the ſame plane, but ſtand a little tranſverſely, or acroſs each other, and thereby preſerve this joint from luxations to which it would be ſubject, if either of the bones was to move on the other perpendicularly up and down without any rotation. Sometimes a moveable ligamentous cartilage is found in this joint; ſometimes it is only interpoſed at the anterior half of it; and in ſome old ſubjects, as Sylvius obſerves, a ſeſamoid bone is found here. The ſcapula is connected to the head, os hyoides, vertebræ, ribs, and arm bone, by muſcles that have one end faſtened to theſe bones, and the other to the ſcapula, which can move it upwards, downwards, backwards, or forwards: by the quick ſucceſſion of theſe motions, its whole body is carried in a circle. But Winſlow thinks, that being alſo often moved as upon an axis perpendicular to its plane, its circumference turns in a circle, whoſe center this axis is. Which ever of theſe motions it performs, it always carries the outward end of the clavicle and arm along with it. The glenoid cavity of this bone receives the os humeri, which plays in it as a ball in a ſocket, as will be explained more hereafter. The uſe of the ſcapula is, to ſerve as a fulcrum to the arm; and by altering its poſitions on different occaſions, to allow always the head of the os humeri a right ſituated ſocket to move in; and thereby to aſſiſt and to enlarge greatly the motions of the ſuperior extremity, and to afford the muſcles which riſe from it more advantageous actions, by altering their directions to the bone which they are to move. This bone alſo ſerves to defend the back part of the thorax, and is often employed to ſuſtain weights, or to reſiſt forces, too great for the arm to bear.

The baſe, acromion, coracoid proceſs, and head of the ſcapula, are all in a cartilaginous ſtate at birth, and the three firſt are joined as epiphyſes; while the head, with the glenoid cavity, is not formed into a diſtinct ſeparate bone, but is gradually produced by the oſſification of the body of this bone being continued forwards.

The arm has only one bone, beſt known by the Latin name of OS HUMERI; which is long, round, and nearly ſtreight. The upper end of this bone is formed into a large, round, ſmooth head, whoſe middle point is not in a ſtreight line with the axis of the bone, but ſtands obliquely backward from it. The extent of the head is diſtinguiſhed by a circular foſſa ſurrounding its baſe, where the head is united to the bone, and the capſular ligament of the joint is fixed. Below the fore-part of its baſe two tubercles ſtand out: the ſmalleſt one, which is ſituated moſt to the inſide, has the tendon of the ſubſcapularis muſcle inſerted into it. The larger more external protuberance is divided at its upper part into three ſmooth plain ſurfaces; into the anterior of which the muſculus ſupra-ſpinatus; into the middle or largeſt, the infra-ſpinatus; into the one behind, the teres minor is inſerted.

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Between theſe two tubercles, exactly in the fore-part of the bone, a deep long foſſa is formed, for lodging the tendinous head of the biceps flexor cubiti, which, after paſſing in a manner peculiar to itſelf, through the cavity of the articulation, is tied down by a tendinous ſheath extended acroſs the foſſa; in which, and in the neighbouring tubercles, are ſeveral remarkable holes, which are penetrated by the tendinous and ligamentous fibres, and by veſſels. On each ſide of this foſſa, as it deſcends in the os humeri, a rough ridge, gently flatted in the middle, runs from the roots of the tubercles. The tendon of the pectoral muſcle is fixed into the anterior of theſe ridges; and the latiſſimus dorſi and teres major are inſerted into the internal one. A little behind the lower end of this laſt, another rough ridge may be obſerved, where the coraco-brachialis is inſerted. From the back part of the root of the largeſt tubercle, a ridge alſo is continued, from which the extenſor brevis cubiti riſes. The bone is flatted on the inſide, about its middle, by the belly of the biceps flexor cubiti. In the middle of this plain ſurface, the entry of the medullary artery is ſeen ſlanting obliquely downwards. At the fore-ſide of this plane the bone riſes in a ſort of ridge, which is rough, and often has a great many ſmall holes in it, where the tendon of the ſtrong deltoid muſcle is inſerted; on each ſide of which the bone is ſmooth and flat, where the brachiæus internus riſes. The exterior of theſe two flat ſurfaces is the largeſt; behind it, a ſuperficial ſpiral channel, formed by the muſcular nerve, and the veſſels that accompany it, runs from behind forwards and downwards. The body of the os humeri is flatted behind by the extenſors of the fore-arm. Near the lower end of this bone a large ſharp ridge is extended on its outſide, from which the muſculus ſpinator radii longus, and the longeſt head of the extenſor carpi radialis riſe. Oppoſite to this there is another ſmall ridge, to which the aponeurotic tendon, that gives origin to the fibres of the internal and external brachiæi muſcles is fixed; and from a little depreſſion on the fore-ſide of it, the pronator radii teres riſes.

The body of the os humeri becomes gradually broader towards the lower end, where it has ſeveral proceſſes, at the roots of which there is a cavity before and another behind. The anterior is divided by a ridge into two; the external, which is the leaſt, receives the end of the radius, and the internal receives the coronoid proceſs of the ulna in the flexions of the fore-arm, while the poſterior deep triangular cavity lodges the olecranon in the extenſions of that member. The bone betwixt theſe two cavities is preſſed ſo thin by the proceſſes of the ulna, as to appear diaphanous in ſeveral ſubjects. The ſides of the poſterior cavity are ſtretched out into two proceſſes, one on each ſide: theſe are called condyles; from each of which a ſtrong ligament goes out to the bones of the fore-arm. The external condyle, which has an oblique direction alſo forwards, in reſpect of the internal, when the arm is in the moſt natural poſture, as Winſlow has remarked in the Memoirs of the Royal Academy of Sciences, 1722, is equally broad, and has an obtuſe ſmooth head riſing from it forwards. From the rough part of the condyle, the inferior head of the bicornis, the extenſor digitorum communis, extenſor carpi ulnaris, anconæus, and ſome part of the ſupinator radii brevis, take their riſe; and on the ſmooth head, the upper end of the radius plays. Immediately on the outſide of this, there is a ſinuoſity made by the ſhorter head of the bicornis muſcle, upon which the muſcular nerve is placed. The internal condyle is more pointed and protuberant than the external, to give origin to ſome part of the flexor carpi radialis, pronator radii teres, palmaris longus, flexor digitorum ſublimis, and flexor carpi ulnaris. Between the two condyles is the trochea or pully, which conſiſts of two lateral protuberances, and a middle cavity, that are ſmooth, and covered with cartilage. When the fore-arm is extended, the tendon of the internal brachiæus muſcle is lodged in the fore-part of the cavity of this pully. The external protuberance, which is leſs than the other, has a ſharp edge behind; but forwards this ridge is obtuſe, and only ſeparated from the little head, already deſcribed, by a ſmall foſſa, in which the joined edges of the ulna and radius move. The internal protuberance of the pully is largeſt and higheſt; and therefore, in the motions of the ulna upon it, that bone would be inclined outwards, was it not ſupported by the radius on that ſide. Between this internal protuberance and condyle, a ſinuoſity may be remarked, where the ulnar nerve paſſes.

The ſubſtance, and the internal ſtructure of the os humeri, is the ſame, and diſpoſed in the ſame way as in other long bones.

The round head at the upper end of this bone is articulated with the glenoid cavity of the ſcapula; which being ſuperficial, and having long ligaments, allows the arm a free and extenſive motion. Theſe ligaments are however conſiderably ſtrong; for beſides the common capſular one, the tendons of the muſcles perform the office, and have been deſcribed under the name of ligaments; then the acromion and coracoid proceſs, with the ſtrong broad ligaments ſtretched betwixt them, ſecure the articulation above, where the greateſt and moſt frequent force is applied to thruſt the head of the bone out of its place. It is true, that there is not near ſo ſtrong a defence at the lower part of the articulation; but in the ordinary poſtures of the arm, that is, ſo long as it is in an acute angle with the trunk of the body, there cannot be any force applied at this place to occaſion a luxation, ſince the joint is protected ſo well above.

The motions which the arm enjoys by this articulation, are to every ſide; and by the ſucceſſion of theſe different motions, a circle may be deſcribed; beſides which, the bone performs a ſmall rotation round its own axis: but though this can be performed with the round head in all poſitions; yet as theſe vary, the effects upon the body of the bone are very different; for if the middle of the head is the center of rotation, as it is when the arm hangs down by the ſide, the body of the bone is only moved forwards and backwards; becauſe the axis of motion of the head is nearly at right angles with the length of the bone, as Hippocrates rightly obſerves in his treatiſe on the Articulations; whereas, when the arm is raiſed to right angles with the trunk of the body, the center of motion and the axis of the bone come to be in the ſame ſtreight line; and therefore the body of the os humeri performs the ſame motion with its head.

Though the motions of the arm ſeem to be very extenſive, yet the larger ſhare of them depends upon the motion of the ſcapula.

The lower end of the os humeri is articulated with the bones of the fore arm, and carries them with it in all its motions, but ſerves as a baſe on which they perform the motions peculiar to themſelves; as ſhall be deſcribed afterwards.

But the ends of this bone are cartilaginous in a new born infant, and the large head with the two tubercles, and the trochlea with the two condyles, become epiphyſes before they are united to the body of the bone.

The fore-arm conſiſts of two long bones, the ulna and radius, whoſe ſituation in reſpect of each other, is oblique in the leaſt ſtraining or moſt natural poſture; that is, the ulna is not directly behind, nor on the outſide of the radius, but in a middle ſituation between theſe two, and the radius croſſes it. The ſituation however of theſe two bones, and of all the other bones of the ſuperior extremity that are not yet deſcribed, is frequently altered; and therefore to ſhun repetitions, I deſire it may be now remarked, that in the remaining account of the ſuperior extremity, I underſtand by the name of poſterior, that part which is in the ſame direction with the back of the hand; by anterior, that anſwering to the palm; by internal, that on the ſame ſide with the thumb; by external, the ſide neareſt to the little finger, ſuppoſing the hand always to be in a middle poſition between pronation and ſupination.

The ulna, ſo named from its being uſed as a meaſure, is the longeſt of the two bones of the fore-arm, and ſituated on the outſide of the radius.

At the upper end of the ulna are two proceſſes: The poſterior is the largeſt, and formed like an hook, whoſe concave ſurface moves on the pulley of the os humeri, and is called olecranon, or top of the cubit. The convex back part of it is rough and ſcabrous, where the longus brevis, and brachiœus externus are inſerted. The olecranon makes it unneceſſary that the tendons of the extenſor muſcles ſhould paſs over the end of the os humeri; which would have been of ill conſequence in the great flexions of this joint, or when any conſiderable external force is applied to this part. The anterior proceſs is not ſo large, nor does it reach ſo high as the one behind; but is ſharper at its end, and therefore is named caronoid. Between theſe two proceſſes, a large ſemicircular or ſigmoid concavity is left; the ſurface of which, on each ſide of the middle riſing, is ſlanting, and exactly adapted to the pulley of the bone of the arm. Acroſs the middle of it there is a ſmall ſinuoſity for lodging mucilaginous glands; where, as well as in a ſmall hollow on the internal ſide of it, the cartilage that lines the reſt of its ſurface is wanting. Round the brims of this concavity the bone is rough, where the capſular ligament of the joint is implanted. Immediately below the olecranon, on the back part of the ulna, a flat triangular ſpongy ſurface appears, on which we commonly lean. At the internal ſide of this, there is a larger hollow ſurface, where the muſculus anconœus is lodged; and the ridge at the inſide of this gives riſe to the muſculus ſupinator radii brevis. Between the top of the ridge and the caronoid proceſs is the ſemilunated ſmooth cavity, lined with a cartilage, in which, and a ligament extended from the one end to the other of this cavity, the round head of the radius plays. Immediately below it, a rough hollow gives lodging to mucilaginous glands. Below the root of the caronoid proceſs, this bone is ſcabrous and unequal, where the brachiœus internus is inſerted. On the outſide of that we obſerve a ſmooth concavity, where the beginning of the flexor digitorum profundus ſprouts out.

The body of the ulna is triangular. The internal angle is very ſharp where the ligament that connects the two bones is fixed. The ſides which make this angle, are flat and rough, by the action and adheſion of the many muſcles which are ſituated here. At the diſtance of one third of the length of the ulna from the top in its fore part, the paſſage of the medullary veſſels is to be remarked ſlanting upwards. The external ſide of this bone is ſmooth, ſomewhat convex, and the angles at each edge of it are blunted by the preſſure of the muſcles equally diſpoſed about them.

As this bone deſcends, it becomes gradually ſmaller; ſo that its lower end terminates in a little head, ſtanding on a ſmall neck. Towards the fore but outer part of which laſt, an oblique ridge runs, that gives riſe to the pronator radii quadratus. The head is round, ſmooth, and covered with a cartilage on its internal ſide, to be received into the ſemilunar cavity of the radius; while a ſtyloid proceſs riſes from its outſide, to which is fixed a ſtrong ligament that is extended to the os cuneiforme and piſiforme of the wriſt. Between the back part of that internal ſmooth ſide and this proceſs, a ſinuoſity is left for the tendon of the extenſor carpi ulnaris. On the fore part of the root of the proceſs, ſuch another depreſſion may be remarked for the paſſage of the ulnar artery and nerve. The end of the bone is ſmooth and covered with a cartilage. Between it and the bones of the wriſt, a double concave moveable cartilage is interpoſed; which is a continuation of the cartilage that covers the lower end of the radius, and is connected looſely to the root of the ſtyloid proceſs, and to the rough cavity there; in which mucilaginous glands are lodged.

The ulna is articulated above with the lower end of the os humeri, where theſe bones have depreſſions and protuberances correſponding with each other, ſo as to allow an eaſy and ſecure extenſion of the fore-arm to almoſt a ſtreight line with the arm, and flection to a very acute angle; but by the ſlanting poſition of the pulley, the lower part of the fore-arm is turned outwards in the extenſion, and inwards in the flexion; and a very ſmall kind of rotation is likewiſe allowed in all poſitions, eſpecially when the ligaments are moſt relaxed by the fore-arm being in a middle degree of flection. The ulna is alſo articulated with the radius and carpus in a manner to be related hereafter.

The radius, ſo called from its imagined reſemblance to a ſpoke of a wheel, or to a weaver's beam, is the bone placed at the inſide of the fore arm. Its upper end is formed into a circular little head, which is hollowed for an articulation with the tubercle at the ſide of the pulley of the os humeri; the half of the round circumference of the head next to the ulna is ſmooth, and covered with a cartilage, in order to be received into the ſemilunated cavity of that bone. Below the head, the radius is much ſmaller; therefore this part is named its cervix, which is made round by the action of the ſupinator radii brevis. At the external root of this neck, a tuberous proceſs riſes; into the outer part of which the biceps flexor cubiti is inſerted. From this a ridge runs downwards and inwards, where the ſupinator radii brevis is inſerted; and a little below and behind this ridge, there is a rough ſcabious ſurface, where the pronator radii teres is fixed.

The body of the radius is not ſtreight, but convex on its internal and poſterior ſurfaces; where it is alſo made round by the equal preſſure of the circumjacent muſcles, particularly of the extenſors of the thumb; but the ſurfaces next the ulna are flatted and rough, for the origin of the muſcles of the hand; and both terminate in a common ſharp ſpine, to which the ſtrong ligament extended between the two bones of the fore-arm is fixed. A little below the beginning of the plain ſurface, on its fore-part, where the flexor muſcle of the laſt joint of the thumb takes its origin, the paſſage of the medullary veſſels is ſeen ſlanting upwards. The radius becomes broader and flatter towards the lower end, eſpecially in its fore-part, where its pronator quadratus muſcle is ſituated.

The lower end of the radius is larger than the ſuperior; though not in ſuch a diſproportion, as the upper end of the ulna is larger than its lower end. Its back part has a flat ſtrong ridge in the middle, and a foſſa on each ſide. In a ſmall groove immediately on the outſide of the ridge, the tendon of the extenſor tertii intermodii policis plays. In a large one beyond this, the tendons of the indicator and of the common extenſor muſcles of the fingers paſs. Contiguous to the ulna, there is a ſmall depreſſion made by the extenſor minimi digiti. On the inſide of the ridge there is a ſmall depreſſion, which ſeems again ſubdivided, where the two tendons of the bicornis, or exenſor carpi radialis, are lodged. The internal ſide of this end of the radius is alſo hollowed by the extenſors of the firſt and ſecond joint of the thumb; immediately above which, a little rough ſurface ſhews where the ſupinator radii longus is inſerted. The ridges at the ſides of the grooves, in which the tendons play, have an annular ligament fixed to them, by which the ſeveral ſheaths for the tendons are formed. The fore-part of this end of the radius is alſo depreſſed, where the flexors of the fingers and flexor carpi radialis paſs. The external ſide is formed into a cavity, ſemilunated ſmooth, lined with a cartilage for receiving the lower end of the ulna. The loweſt part of the radius is formed into an oblong cavity; in the middle of which is a ſmall tranſverſe riſing, gently hollowed, for lodging mucilaginous glands; while the riſing itſelf is inſinuated into the conjunction of the two bones of the wriſt that are received into the cavity. The internal ſide of this articulation is fenced by a remarkable proceſs of the radius, from which a ligament goes out to the wriſt, as the ſtyloid proceſs of the ulna with its ligament guards it on the outſide.

The ends of both the bones of the fore-arm being thicker than the middle, there is a conſiderable diſtance between the bodies of theſe bones; in the larger part of which a ſtrong tendinous, but thin ligament, is extended, to give a ſurface large enough for the origin of the numerous fibres of the muſcles ſituated here, that are ſo much ſunk between the bones, as to be protected from injuries, which they would otherwiſe be expoſed to. But this ligament is wanting near the upper end of the fore arm, where the ſupinator radii brevis, and flexor digitorum profundus are immediately connected.

Both ends of the bones of the fore-arm are firſt cartilages, and then epiphyſes in children.

As the head of the radius receives the tubercle of the os humeri, it is not only bent and extended along with the ulna, but may be moved round its axis in any poſition; and that this motion round its axis may be ſufficiently large, the ligament of the articulation is extended farther down than ordinary on the neck of this bone before it is connected to it; and it is very thin at its upper and lower parts, but makes a firm ring in the middle. This bone is alſo joined to the ulna by a double articulation; for above, a tubercle of the radius plays in a ſocket of the ulna; whilſt below the radius gives the ſocket, and the ulna the tubercle: but the motion performed in theſe two, is very different; for at the upper end, the radius does no more than turn round its axis; while at the lower end, it moves in a ſort of cycloid on the round part of the ulna; and as the hand is articulated and firmly connected here with the radius, they muſt move together. When the palm is turned uppermoſt, the radius is ſaid to perform the ſupination; when the back of the hand is above, it is ſaid to be prone. But then the quickneſs and large extent of theſe two motions are aſſiſted by the ulna, which, as was before obſerved, can move with a kind of ſmall rotation on the ſloping ſides of the pulley. This lateral motion, though very inconſiderable in the joint itſelf, is conſpicuous at the lower end of ſuch a long bone; and the ſtrong ligament connecting this lower end to the carpus makes the hand more readily obey theſe motions. When we deſign a large circular turn of the hand, we increaſe it by the rotation of the os humeri, and ſome times employ the ſpine and inferior extremities to make theſe motions, of pronation or ſupinaton, of the hand large enough.

The hand comprehends all from the joint of the wriſt to the points of the fingers. Its back-part is convex, for greater firmneſs and ſtrength; and its fore part is concave for containing more ſurely and conveniently ſuch bodies as we take hold of. One half of the hand has an obſcure motion in compariſon of what the other has, and ſerves as a baſe to the moveable half; which can be extended back very little farther than to a ſtreight line with the fore-arm, but can be conſiderably bent forwards.

As the bones which compoſe the hand are of different ſhapes and uſes, while ſeveral of them that are contiguous agree in ſome general characters; the hand, on this account, is commonly divided into the carpus, metacarpus, and fingers; among which laſt the thumb is reckoned.

The carpus is compoſed of eight ſmall ſpongy bones ſituated at the upper part of the hand. Theſe bones will be deſcribed under a proper name taken from their figure; becauſe the method of ranging them by numbers, leaves anatomiſts too much at liberty to debate very idly which ought to be preferred to the firſt number; or, which is worſe, ſeveral, without explaining the order they obſerve, differently apply the ſame numbers, and ſo confound their readers. But that the deſcription of theſe bones may be in the ſame order as they are found in the generality of anatomical books, I ſhall begin with the range of bones that are concerned in the moveable joint of the wriſt, or are connected to the fore-arm, and ſhall afterwards conſider the four that ſupport the thumb and oſſa metacarpi of the fingers.

The eight bones of the carpus are, os ſcaphoides, lunare, cuneiforme, piſiforme, trapezium, trapezoides, magnum, and unciforme.

The ſcaphoides is ſituated moſt internally of thoſe that are articulated with the fore-arm. The lunare is immediately on the outſide of the former. The cuneiforme is placed ſtill more externally, but does not reach ſo high up as the other two. The piſiforme ſtands forwards into the palm from the cuneiforme. The trapezium is the firſt of the ſecond row, and is ſituated between the ſcaphoides and the firſt joint of the thumb. The trapezoides is immediately on the outſide of the trapezium. The os magnum is ſtill more external. The unciforme is farther to the ſide of the little finger.

The os ſcaphoides is the largeſt of the eight, except one. It is convex above, concave and oblong below; from which ſmall reſemblance of a boat it has got its name. Its ſmooth convex ſurface is divided by rough middle foſſa, which runs obliquely acroſs it. The upper largeſt diviſion is articulated with the radius. Into the foſſa the common ligament of the joint of the wriſt is fixed, and the lower diviſion is joined to the trapezium and trapezoides. The concavity receives more than an half of the round of the head of the os magnum. The external ſide of this hollow is formed into a ſemilunar plane, to be articulated with the following bone. The internal, poſterior, and anterior edges are rough for fixing the ligaments that connect it to the ſurrounding bones.

The os lunare has a ſmooth, convex, upper ſurface, by which it is articulated with the radius. The internal ſide, which gives the name to the bone, is in the form of the creſcent, and is joined with the ſcaphoid; the lower ſurface is hollowed, for receiving part of the head of the os magnum. On the outſide of this cavity is another ſmooth, but narrow, oblong ſinuoſity, for receiving the upper end of the os unciforme. On the outſide of which a ſmall round convexity is found, for its connection with the os cuneiforme. Between the great convexity above, and the firſt deep inferior cavity, there is a rough foſſa, in which the circular ligament of the joint of the wriſt is fixed.

The os cuneiforme is broader above, and towards the back of the hand, than it is below and forwards; which gives it the reſemblance of a wedge. The ſuperior ſlightly convex ſurface is included in the joint of the wriſt, being oppoſed to the lower end of the ulna. Below this the cuneiform bone has a rough foſſa, wherein the ligament of the articulation of the wriſt is fixed. On the internal ſide of this bone, where it is contiguous to the os lunare, it is ſmooth and ſlightly concave. Its lower ſurface, where it is contiguous to the os unciforme is oblong, ſomewhat ſpiral and concave. Near the middle of its anterior ſurface a circular plane appears, where the os piſiforme is ſuſtained.

The os piſiforme is almoſt ſpherical, except one circular plane, or ſlightly hollow ſurface, which is covered with cartilage for its motion on the cuneiform bone, from which its whole rough body is prominent forwards into the palm; having the tendon of the flexor carpi ulnaris, and a ligament from the ſtyloid proceſs of the ulna, fixed to its upper part; the tranſverſe ligament of the wriſt is connected to its internal ſide; ligaments extended to the cuneiform bone, and to the os metacarpi of the little finger, are attached to its lower parts; the abductor minimi digiti has its origin from its fore-part; and at the internal ſide of it, a ſmall depreſſion is formed, for the paſſage of the ulnar nerve.

The trapezium has four unequal ſides and angles in its back part, from which it has got its name. Above, its ſurface is ſmooth, ſlightly hollowed, and ſemi-circular, for its conjunction with the os ſcaphoides. Its external ſide is an oblong concave ſquare, for receiving the following bone. The inferior ſurface is formed into a pulley; the two protuberant ſides of which are external and internal. On this pulley the firſt bone of the thumb is moved. At the external ſide of the external protuberance a ſmall, oblong, ſmooth ſurface is formed by the os metacarpi indicis. The fore-part of the trapezium is prominent in the palm, and, near to the external ſide, has a ſinuoſity in it, where the tendon of the flexor carpi radialis is lodged; on the ligamentous ſheath of which, the tendon of the flexor tertii internodii pollicis plays: and ſtill more externally the bone is ſcabrous, where the tranſverſe ligament of the wriſt is connected, the abductor and flexor primi internodii pollicis have their origin, and ligaments go out to the firſt bone of the thumb.

The os trapezoides, ſo called from the irregular figure of its back-part, is the ſmalleſt bone of the wriſt, except the piſiforme. The figure of it is an irregular cube. It has a ſmall quadrangular hollow ſurface above, by which it joins the ſcaphoides; a long, convex one internally, where it is contiguous to the trapezium; a ſmall external one, for its conjunction with the os magnum; and an inferior convex ſurface, the edges of which are however raiſed before and behind, that a ſort of pulley is formed, where it ſuſtains the os metacarpi indicis.

The os magnum, ſo called, becauſe it is the largeſt bone of the carpus, is oblong, having four quadrangular ſides, with a round upper end, and a triangular plain one below. The round head is divided by a ſmall riſing oppoſite to the connection of the os ſcaphoides and lunare, which together form the cavity for receiving it. On the inſide a ſhort plain ſurface joins the os magnum to the trapezoides. On the outſide is a long, narrow, concave ſurface, where it is contiguous to the os cuneiforme. The lower end, which ſuſtains the metacarpal bone of the middle finger, is triangular, ſlightly hollowed, and further advanced on the internal ſide, than on the external, having a conſiderable oblong depreſſion made on the advanced inſide by the metacarpal bone of fore-finger; and generally there is a ſmall mark of the os metacarpi digiti annularis on its external ſide.

The os unciforme has got its name from a thin, broad proceſs, that ſtands out from it forward into the palm, and is hollow on its inſide, for affording paſſage to the tendons of the flexors of the fingers. To this proceſs alſo, the tranſverſe ligament is fixed, that binds down and defends theſe tendons; and the flexor, and abductor muſcles of the little finger have part of their origin from it. The upper plain ſurface is ſmall, convex, and joined with the os lunare: the internal ſide is long, and ſlightly convex, adapted to the contiguous os magnum. The external ſurface is oblique, and irregularly convex, to be articulated to the cuneiforme bone: the lower end is divided into two concave ſurfaces; the external is joined with the metacarpal bone of the little finger, and the internal one is fitted to the metacarpal bone of the ring-finger.

In the deſcription of the preceding eight bones, I have only mentioned thoſe plain ſurfaces covered with cartilage, by which they are articulated to each other, or to ſome other bones, except in ſome few caſes, where ſomething extraordinary was to be obſerved: and I have deſignedly omitted the other rough ſurfaces, leſt by crowding too many words in the deſcription of ſuch ſmall bones, the whole would be unintelligible: but theſe ſcabrous parts of the bones may be eaſily underſtood, after mentioning their figure, if it is obſerved, that they are generally found, only towards the back or palm of the hand; that they are all plain, larger behind than before, and that they receive the different ligaments, by which they are either connected to neighbouring bones, or to one another; for theſe ligaments cover all the bones, and are ſo accurately applied to them, that at firſt view, the whole carpus of a recent ſubject appears one ſmooth bone.

As the ſurfaces of theſe bones are largeſt behind, the figure of the whole conjoined muſt be convex there, and concave before; which cavity is ſtill more encreaſed by the os piſiforme, and the proceſs of the os unciforme ſtanding forwards on the one ſide, as the trapezium does on the other: and the bones are ſecurely kept in this form, by the broad, ſtrong, tranſverſe ligaments, connected to theſe parts of them, which ſtand prominent in the palm of the hand. The convexity behind renders the whole fabric ſtronger, where it is moſt expoſed to injuries;

and the large anterior hollow is neceſſary for a ſafe paſſage to the numerous veſſels, nerves, and tendons of the fingers.

The ſubſtance of theſe bones is ſpongy and cellular, but ſtrong in reſpect of their bulk.

The three firſt bones of the carpus make an oblong head, by which they are articulated with the cavity at the lower ends of the bones of the fore-arm, ſo as to allow motion to all ſides, and by a quick ſucceſſion of theſe motions, they may be moved in a circle. But as the joint is oblong, and, therefore, the two dimenſions are unequal, no motion is allowed to the carpus round its axis, except what it has in the pronation and ſupination with the radius. The articulation of the firſt three bones of the ſuperior row, with the bones of the inferior, is ſuch as allows of motion, eſpecially backwards and forwards; to the ſecurity and eaſineſs of which the reception of the os magnum into the cavity formed by the ſcaphoides and lunare contributes conſiderably: and the greateſt number of the muſcles that ſerve for the motion of the wriſt on the radius, being inſerted beyond, the conjunction of the firſt row of bones with the ſecond, act equally on this articulation as they do on the former; but the joint formed with the radius being the moſt eaſily moved, the firſt effect of theſe muſcles is on it; and the ſecond row of the carpus is only moved afterwards. By this means a larger motion of the wriſt is allowed than otherwiſe it could ſafely have: for, if as great a motion had been given to one joint, the angle of flexion would have been very acute, and the ligaments muſt have been longer than was conſiſtent with the firmneſs and ſecurity of the joint. The other articulations of the bones here, being by nearly plain ſurfaces, ſcarce allow of any more motion, becauſe of the ſtrong connecting ligaments, than to yield a little, and ſo elude the force of any external power; and to render the back of the wriſt a little more flat, or the palm more hollow on proper occaſions. The articulations of the thumb and metacarpal bones ſhall be examined hereafter.

The uſes of the carpus are to ſerve as a baſe to the hand, to protect its tendons, and to afford it a large, free motion.

All the bones of the carpus are in a cartilaginous ſtate at the time of birth. On account of the many tendons that paſs on the lower end of the fore-arm and the carpus, and of the numerous ligaments of theſe tendons, and of the bones, which have lubricating liquors ſupplied to them, the pain of ſprains here is acute, the parts take a long time to recover their tone, and their ſwellings are very obſtinate.

The metacarpus conſiſts of four bones, which ſuſtain the fingers; each bone is long and round, with its ends larger than its body. The upper end, which ſome call the baſe, is flat and oblong, without any conſiderable head or cavity; but is, however, ſomewhat hollowed, for the articulation with the carpus: it is made flat and ſmooth on the ſides, where theſe bones are contiguous to each other: their bodies are flatted on their back parts by the tendons of the extenſors of the fingers. The anterior ſurface of theſe bodies is a little concave, eſpecially in their middle; along which a ſharp ridge ſtands out, which ſeparates the muſculi interoſſei placed on each ſide of theſe bones which are there made flat and plain by theſe muſcles.

Their lower ends are raiſed into large oblong ſmooth heads, whoſe greateſt extent is forwards from the axis of the bone.—At the fore-part of each ſide of the root of each of theſe heads, ſtand out one or two tubercles, for fixing the ligaments that go from one metacarpal bone to another, to preſerve them from being drawn aſunder. A rough ring may be remarked round the heads, for the capſular ligaments of the firſt joints of the fingers to be fixed to; and both ſides of theſe heads are flat, by preſſing on each other.

The metacarpal bones are of the ſame ſubſtance with that of all long bones.

At the time of birth, theſe bones are cartilaginous at both ends, which afterwards become epiphyſes.

The metacarpal bones are joined above to the oſſa carpi and to each other by nearly plain ſurfaces. Theſe connexions are not fit for large motions.

The concavity on the fore-part of theſe metacarpal bones, and the placing their baſes on the arched carpus, cauſe them to form a hollow in the palm of the hand, which is often uſeful to us.—The ſpaces between them lodge muſcles, and their ſmall motion makes them proper ſupporters for the fingers to play on.

Though the oſſa metacarpi ſo far agree, they may yet be diſtinguiſhed from each other by the following marks.

The os metacarpi indicis is in general the longeſt.—Its baſe, which is articulated with the os trapezoides, is hollow in the middle.—The ſmall ridge on the internal ſide of this oblong cavity is ſmaller than that which is oppoſite to it, and is made flat on the ſide by the trapezium.—The exterior ridge is alſo ſmooth, and flat on its outſide, for its conjunction with the os magnum; immediately below which a ſemicircular ſmooth flat ſurface ſhews the articulation of this to the ſecond metacarpal bone. The back part of this baſe is flatted, where the long head of the extenſor carpi radialis is inſerted; and its fore-part is prominent, where the tendon of the flexor carpi radialis is fixed. The external ſide of the body of this bone is more hollowed by the action of muſcles, than the internal. The tubercle at the internal root of its head is larger than the external. Its baſe is ſo firmly fixed to the bone it is connected with, that it is without motion.

The os metacarpi medii digiti is generally the ſecond in length; it is, however, frequently as long as the former; ſometimes it is longer; and frequently it appears only to equal the firſt by the os magnum being farther advanced downwards than any other bone of the wriſt. Its baſe is a broad ſuperficial cavity, ſlanting outwards; the internal poſterior angle of which is ſo prominent, as to have the appearance of a proceſs. The internal ſide of this baſe is made plain in the ſame way as the external ſide of the former bone, while its external ſide has two hollow circular ſurfaces, for joining the third metacarpal bone, and between theſe ſurfaces there is a rough foſſa for the adheſion of a ligament, and lodging mucilaginous glands. The ſhorter head of the bicornis is inſerted into the back-part of this baſe. The two ſides of this bone are almoſt equally flatted; only the ridge on the fore-part of the body inclines outwards. The tubercles at the fore-part of the root of the head are equal. This bone has very little more motion than the firſt metacarpal one has; and therefore theſe two firmly reſiſt bodies preſſed againſt them by the thumb, or figures, or both.

The os metacarpi digiti annularis is ſhorter than the ſecond metacarpal bone. Its baſe is ſemicircular and convex, for its conjunction with the os unciforme. On its internal ſide are two ſmooth convexities, and a middle foſſa, adapted to the ſecond metacarpal bone. The external ſide has a triangular ſmooth concave ſurface to join it with the fourth one. The anterior ridge of its body is ſituated more to the out than to the inſide. The tubercles near the head are equal. The motion of this third metacarpal bone is greater than that of the ſecond.

The os metacarpi minimi digiti is the ſmalleſt and ſharpeſt. Its baſe is irregularly convex, and riſes ſlanting outwards. Its internal ſide is exactly adapted to the third metacarpal bone. The external has no ſmooth ſurface, becauſe it is not contiguous to any other bone; but it is prominent where the extenſor carpi ulnaris is inſerted. This metacarpal bone being furniſhed with a proper moving muſcle, having the plaineſt articulation, and being moſt looſely connected and leaſt confined, it not only enjoys a much greater motion than any of the reſt, but draws the third bone with it, when the palm of the hand is to be made hollow by its advancement forwards, and by the prominence of the thumb oppoſite to it.

The THUMB and four FINGERS are each compoſed of three long bones. The thumb is ſituated obliquely in reſpect of the fingers, neither directly oppoſite to them, nor in the ſame plane with them. All the bones of the thumb are much thicker and ſtronger in proportion to their length, than thoſe of the fingers are: which was extremely neceſſary, as the thumb counteracts all the fingers.

The firſt bone of the thumb has its baſe adapted to the double pulley of the trapezium: for in viewing it from one ſide to the other, it appears convex in the middle; but when conſidered from behind forwards, it is concave there. The edge at the fore-part of this baſe is produced farther than any other part; and round the back-part of the baſe a rough foſſa may be ſeen, for the connection of the ligaments of this joint. The body and head of this bone are of the ſame ſhape as the oſſa metacarpi; except that the body is ſhorter, and the head flatter, with the tubercles at the fore-part of its root larger.

The articulation of the upper end of this bone is uncommon: for though it has protuberances and depreſſions adapted to the double pulley of the trapezium, yet it enjoys a circular motion, as the joints do where a round head of one bone plays in the orbicular ſocket of another; but it is ſomewhat more confined and leſs expeditious, but ſtronger and more ſecure than ſuch joints uſually are.

This bone of children is in the ſame ſtate with the metacarpal bones.

The ſecond bone of the thumb has a large baſe formed into an oblong cavity, whoſe greateſt length is from one ſide to the other. Several tubercles may be remarked round it, for the inſertion of ligaments. Its body is convex, or a half-round behind; but flat before, for lodging the tendon of the long flexor of the thumb, which is tied down by ligamentous ſheaths that are fixed on each ſide to the angle at the edge of this flat ſurface. The lower end of this ſecond bone has two lateral round protuberances, and a middle cavity, whoſe greateſt extent of ſmooth ſurface is forwards. The articulation and motion of the upper end of this ſecond bone is alſo ſingular. For its cavity being joined to the round head of the firſt bone, it would ſeem at firſt view to enjoy motion in all directions; yet becauſe of the ſtrength of its lateral ligaments, oblong figure of the joint itſelf, and mobility of the firſt joint, it only allows flexion and extenſion; and theſe are generally much confined.

The third is the ſmalleſt bone of the thumb, with a large baſe, whoſe greateſt extent is from one ſide to the other. This baſe is formed into two cavities and a middle protuberance, to be adapted to the pulley of the former bone. Its body is rounded behind; but is flatter than in the former bone, for ſuſtaining the nail. It is flat and rough before, by the inſertion of the flexor tertii internodii. This bone becomes gradually ſmaller, till near the lower end, where it is a little enlarged, and has an oval ſcabrous edge. The motion of this third bone is confined to flexion and extenſion.

The orderly diſpoſition of the bones of the fingers into three rows, has made them generally obtain the name of three phalanges. They all have half round convex ſurfaces, covered with an aponeuroſis, formed by the tendons of the extenſors, lumbricales, and interoſſei, and placed directly backwards for their greater ſtrength, and their flat concave part is forwards, for taking hold more certainly, and for lodging the tendons of the flexor muſcles. The ligaments for keeping down theſe tendons are fixed to the angles that are between the convex and concave ſides.

The bones of the firſt phalanx of the fingers, correſpond with the deſcription of the ſecond bone of the thumb: except that the cavity in their baſe is not ſo oblong; nor is their motion on the metacarpal bone ſo much confined: for they can be moved laterally or circularly, but have no rotation or a very ſmall degree of it round their axis. Both the ends of this firſt phalanx are in a cartilaginous ſtate at the birth; and the upper one is afterwards affixed in form of an epiphyſe.

The ſecond bone of the fingers has its baſe formed into two lateral cavities, and a middle protuberance; while the lower end has two lateral protuberances and a middle cavity; therefore it is joined at both ends in the ſame manner, which none of the bones of the thumb are. This bone in children is in the ſame condition with the former.

The third bone only differs from the deſcription of the third bone of the thumb, in the general diſtinguiſhing marks; therefore the ſecond and third phalanx of the fingers, enjoy only flexion and extenſion. The upper end of this third phalanx is a cartilage in a ripe child; and is only an epiphyſe after, till the full growth of the body.

All the difference of the phalanges of the ſeveral fingers, conſiſt in their magnitude. The bones of the middle finger, being the longeſt and largeſt, thoſe of the fore-finger are next to that in thickneſs, but not in length, for thoſe of the ring-finger are a little longer. The little finger has the ſmalleſt bones. Which diſpoſition is the beſt contrivance for holding the largeſt bodies; becauſe the longeſt fingers are applied to the middle largeſt periphery of ſuch ſubſtances as are of a ſpherical figure.

Of the INFERIOR EXTREMITIES.

The inferior extremities depend from the acetabula of the oſſa innominata; are commonly divided into three parts, viz. the thigh, leg, and foot.

The thigh has but one bone; which is the longeſt of the body, and the largeſt and ſtrongeſt of any of the cylindrical bones. The ſituation of it is not perpendicular: for the lower end is inclined conſiderably inwards; ſo that the knees are almoſt contiguous, while there is a conſiderable diſtance between the thigh-bones above; which is of conſiderable uſe to us, ſince ſufficient ſpace is thereby left for the external parts of generation, the two great cloacæ of urine and fœces, and for the large thick muſcles that move the thigh inwards: and at the ſame time this ſituation of the thigh-bones renders our progreſſion quicker, ſurer, ſtraiter, and in leſs room; for had the knees been farther from each other, we muſt have been obliged to deſcribe ſome part of a circle with the trunk of our body in making a long ſtep, and, when one leg was raiſed from the ground, our center of gravity would have been too far from the baſe of the other, and we ſhould conſequently have been in danger of falling; ſo that our ſteps would neither have been ſtrait nor firm; nor would it have been poſſible to walk in a narrow path, had our thigh-bones been otherwiſe placed.

The upper end of the thigh-bone is not continued in a ſtrait line with the body of it, but is ſet off obliquely inwards and upwards, whereby the diſtance here between theſe two bones at their upper part is conſiderably increaſed. This end is formed into a large ſmooth round head, which is the greater portion of a ſphere unequally divided. Towards its lower internal part a round rough ſpongy pit is obſervable, where the ſtrong ligament commonly, but improperly, called the round one, is fixed, to be extended from thence to the lower internal part of the receiving cavity, where it is conſiderably broader than near to the head of the thigh-bone. The ſmall part below the head, called the cervix of the os femoris, has ſeveral large holes into which the fibres of the ſtrong ligament, continued from the capſular, enter, and are thereby ſurely united to it; and round the root of the neck, where it riſes from the bone, a rough ridge is found, where the capſular ligament of the articulation itſelf is connected. Below the back part of this root, the large unequal protuberance, called trochanter major, ſtands out; the external convex part of which is diſtinguiſhed into three different ſurfaces, whereof the one on the fore-part is ſcabrous and rough, for the inſertion of the glutæus minimus; the ſuperior one is ſmooth, and has the glutæus medius inſerted into it; and that behind is made flat and ſmooth by the tendon of the glutæus maximus paſſing over it. The upper edge of this proceſs is ſharp and pointed as its back part, where the glutæus medius is fixed; but forwards it is more obtuſe, and has two ſuperficial pits formed in it: into the ſuperior of theſe, the piriformis is implanted; and the obturator internus and gemini are fixed into the lower one. From the backmoſt prominent part of this great trochanter, a rough ridge runs backwards and downwards, into which the quadratus is inſerted. In the deep hollow, at the internal upper ſide of this ridge, the obturator externus is implanted. More internally, a conoid proceſs, called trochanter minor, riſes for the inſertion of the muſculus pſoas, and iliacus internus, and the pectineus, is implanted into a rough hollow below its internal root. The tendons that are fixed into, or paſs over the great trochanter, cauſe bruiſes by falls on this part to be attended with great pain and weakneſs of the limb, which generally are of long duration.

The body of the os femoris is convex on the fore-part, and made hollow behind, by the action of the muſcles that move it and the leg, and for the conveniency of ſitting, without bearing too much on theſe muſcles; and perhaps the weight of the legs depending from the thighs in that poſture, contributes to this curvature. The fore-part of the thigh-bone is a little flatted above by the beginning of the cruræus muſcle, as it is alſo below by the ſame muſcle and the rectus. Its external ſurface is alſo made flat below by the vaſtus externus, where it is ſeparated from the former by an obtuſe ridge. The vaſtus internus depreſſes a little the lower part of the internal ſurface. The poſterior concave ſurface has a ridge riſing in its middle, commonly called linea aſpera, into which the triceps is inſerted, and the ſhort head of the biceps flexor tibiæ riſes from it. At the upper part of it, the medullary veſſels enter by a ſmall hole that runs obliquely upwards; a little above which, there is a rough foſſa or two, where the tendon of the glutæus maximus is fixed. The lower end of the linea aſpera divides into two, which deſcend towards each ſide. The two vaſti muſcles have part of their origin from theſe ridges; and the long tendon of the triceps is fixed to the internal, by means of part of the faſcia aponeurotica of the thigh. Near the beginning of the internal ridge, there is a diſcontinuation of the ridge, where the crural artery paſſes through the aponeuroſis. Between theſe two rough lines, the bone is rendered flat, by the large blood-veſſels and nerves which paſs upon it; and near the end of each of theſe ridges, a ſmall ſmooth protuberance may frequently be remarked, where the two heads of the external gaſtrocnemius muſcle take their riſe, and where ſeſamoid bones are ſometimes found; and from the fore-part of the internal tubercle, a ſtrong ligament is extended to the inſide of the tibia.

The lower end of the os femoris is larger than any other part of it, and is formed into a great protuberance on each ſide, called its condyles; between which is found a conſiderable cavity, eſpecially at the back-part, in which the crural veſſels and nerves lie immerſed in fat. The internal condyle is longer than the external, which muſt be the caſe, from the oblique poſition of this bone, to give leſs obliquity to the leg. Each of theſe proceſſes ſeems to be divided in its plain ſmooth ſurface. The mark of diviſion on the external is a notch, and on the internal a ſmall protuberance. The fore-part of this diviſion, on which the rotula moves, is formed like a pulley, the external ſide of which is higheſt. Behind, there are two oblong large heads, whoſe greateſt extent is backwards, for the motion of the tibia; and from the rough cavity between them, but near to the baſe of the internal condyle, the ſtrong ligament uſually called the croſs one, has its riſe; a little above which, a rough protuberance gives inſertion to the tendon of the triceps.

The condyles, both on the outer and inner ſide of the knee, are made flat by the muſcles paſſing along them. On the back-part of the internal, a ſlight depreſſion is made by the tendons of the gracilis and ſartorius; and on the external ſuch another is formed by the biceps flexor cruris; behind which a deep foſſa is to be obſerved, where the poplitæus muſcle has its origin. From the tubercle immediately before this cavity, a ſtrong round ligament goes out to the upper part of the fibula. Round this lower end of the thigh-bone, there are found large holes, into which the ligaments for the ſecurity of the joint are fixed, and blood-veſſels paſs to the internal ſubſtance of the bone.

All the proceſſes of the femur are cartilaginous in new-born children, and afterwards become ſmall apophyſes, with large epiphyſes.

The thigh-bone being articulated above with the acetabulum of the oſſa innominata, which affords its round head a ſecure and extenſive play, can be moved to every ſide; but is reſtrained in its motion outwards, by the high brims of the cavity, and by the round ligament; otherwiſe the head of the bone would have been frequently thruſt out at the breach of the brims on the inſide, which allows the thigh to move conſiderably inwards.

The body of this bone has little or no rotatory motion, though the head generally moves round its own axis; becauſe ſuch is the oblique progreſs of the neck and head from the bone, that the rotatory motion of the head can only bring the body of the bone forwards and backwards: nor is this head, as in the arm, ever capable of being brought to a ſtreight direction with its body; ſo far however as the head can move within the cavity backwards and forwards, the reſt of the bone may have a partial rotation.

When the thigh-bone reſiſts the actions of its muſcles, more than the trunk of the body can then do, as in ſtanding, theſe muſcles have their effect on the trunk, cauſing it to bend forward, raiſing it up, inclining it to the one or the other ſide, twiſting it obliquely, &c. which the rolling of the acetabula of the oſſa innominata on the round heads of the thigh-bones is well fitted for. The os femoris is articulated below to the tibia and rotula.

The proximity of the ſmall neck to the round head of the thigh-bone, and its upper end being covered with very thick muſcles, make greater difficulty in diſtinguiſhing between a luxation and fracture here, than in any other part of the body.

The leg is generally ſaid to be compoſed of two bones, tibia and fibula, though it ſeems to have a very good title to a third, the rotula; which bears a ſtrong analogy to the olecranon of the ulna, and always moves with the other two.

The tibia, ſo called from its reſemblance to an old muſical pipe or flute, is the long, thick, triangular bone, ſituated at the internal part of the leg, and continued in almoſt a ſtreight line from the thigh-bone.

The upper end of the tibia is large, bulbous and ſpongy, and is divided into two cavities, by a rough irregular protuberance which is hollow at its moſt prominent part, as well as before and behind. The anterior of the two ligaments which compoſe the great croſs one, is inſerted into the middle cavity, and the depreſſion behind receives the poſterior ligament.

The two broad cavities at the ſides of this protuberance are not equal; the internal being oblong and deep, to receive the internal condyle of the thigh-bone, while the external is more ſuperficial and rounder, for the external condyle.

In each of theſe two cavities of a recent ſubject, a ſemilunar cartilage is placed, which is thick at its convex edge, and becomes gradually thinner towards the concave or interior edge.

The middle of each of theſe cartilages is broad, and the ends turn narrower and thinner, as they approach the middle protuberance of the tibia.

The thick convex edge of each cartilage is connected to the capſular and other ligaments of the articulation, but ſo near to their riſe from the tibia, that the cartilages are not allowed to change place far; while the narrow ends of the cartilages becoming almoſt ligaments, are fixed at the inſertion of the ſtrong croſs ligament into the tibia, and ſeem to have their ſubſtance united with it; a circular hole is therefore left between each cartilage and the ligament, in which the moſt prominent convex part of each condyle of the thigh-bone moves.

The circumference of theſe cavities is rough and unequal for the firm connection of the ligaments of the joint.

Immediately below the edge at its back-part, two rough flatted protuberances ſtand out: into the internal, the tendon of the ſemimembrabranoſus muſcle is inſerted; and a part of the croſs ligament is fixed to the external.— On the outſide of this laſt tubercle, a ſmooth ſlightly-hollowed ſurface is formed by the action of the poplitæus muſcle.

Below the fore-part of the upper end of the tibia, riſes a conſiderable rough protuberance, to which the ſtrong tendinous ligament of the rotula is fixed.—— There is on the internal ſide of this, a broad ſcabrous ſlightly-hollowed ſurface, to which the internal long ligament of the joint, the aponeuroſis of the vaſtus internus, and the tendons of the ſeminervoſus, gracilis, and ſartorius, are fixed.—— Therefore the loweſt part of this ſurface is the place where the tibia ought to be ſawed thro' in an amputation, ſo as not to have too long and troubleſome a ſtump, and, at the ſame time, to preſerve its motions, by ſaving the proper muſcles.

Below the external edge of the upper end of the tibia, there is a circular flat ſurface, covered in a recent ſubject with cartilage, for the articulation of the fibula;—— between which and the anterior knob, there is a rough hollow from which the tibialis anticus, and extenſor digitorum longus, take their origin.

From the ſmooth flat ſurface, a ridge runs obliquely downwards and inwards, to give riſe to part of the ſolæus, tibialis poſticus, and flexor digitorum longus, and inſertion to the aponeuroſis of the ſemimembranoſus which covers the poplitæus, and to ſome of the external fibres of this laſt named muſcle. At the inſide of this ridge an oblique plain ſurface is left, where the greateſt part of the muſculus poplitæus is inſerted. The remaining body of the tibia is triangular. The anterior angle is very ſharp, and is uſually called the ſpine or ſhin. This ridge is not ſtreight; but turns firſt inwards, then outwards, and laſtly inwards again. The plain internal ſide is ſmooth and equal, not being much ſubject to the actions of muſcles; but the external ſide is hollowed above by the tibialis anticus, and below by the extenſor digitorum longus and extenſor pollicis longus. The two angles behind theſe ſides are rounded by the action of the muſcles; the poſterior ſide comprehended between them is not ſo broad as thoſe already mentioned, but is more oblique and flatted by the action of the tibialis poſticus and flexor digitorum longus. Some diſtance above the middle of the bone, the internal angle terminates, and the bone is made round by the preſſure of the muſculus ſolæus. Near to this, the paſſage of the medullary veſſels is ſeen ſlanting obliquely downwards.

The lower end of the tibia is made hollow, but ſo as a ſmall protuberance riſes in the middle. The internal ſide of this cavity, which is ſmooth, and, in a recent ſubject covered with cartilage, is produced into a conſiderable proceſs, commonly named malleolus internus; the point of which is divided by a notch, and from it ligaments are ſent out to the foot.

It is to be obſerved here, that this internal malleolus is ſituated more forwards than the internal condyle of the upper end of this bone; which is neceſſary to be remembered in reducing a fracture of the leg.

The external ſide of this end of the tibia has a rough irregular ſemilunar cavity formed in it, for receiving the lower end of the fibula. The poſterior ſide has two lateral grooves, and a ſmall protuberance. In the internal depreſſion, the tendons of the muſculus tibialis poſticus and flexor digitorum longus are lodged; and in the external, the tendon of the flexor longus policis plays. From the middle protuberance go out ligamentous ſheaths, for tying down theſe tendons.

Both ends of the tibia are cartilages at birth, and become afterwards epiphyſes.

The fibula is the ſmall long bone, placed on the outſide of the leg, oppoſite to the external angle of the tibia; the ſhape of it is irregularly triangular.

The head of the fibula has a ſuperficial circular cavity formed on its inſide, which in a recent ſubject, is covered with a cartilage, but ſo cloſely connected to the tibia by ligaments, as only to allow a ſmall motion backwards and forwards. This head is protuberant and rough on its outſide, where a ſtrong round ligament and the muſculus biceps are inſerted; and, below the back-part of its internal ſide, a tubercle may be obſerved, that gives riſe to the ſtrong tendinous part of the ſolæus muſcle.

The body of this bone is ſomewhat crooked inwards and backwards, which figure is owing to the actions of the muſcles; but is ſtill further increaſed by nurſes, who frequently hold children by the legs in a careleſs manner. The ſharpeſt angle of the fibula is forwards, on each ſide of which the bone is conſiderably but unequally depreſſed by the bellies of the ſeveral muſcles that riſe from, or act upon it; and, in old people, theſe muſcles make diſtinct ſinuoſities for themſelves.

The external ſurface of the fibula is depreſſed obliquely from above downwards and backwards, by the two peronæi. Its internal ſurface is unequally divided into two narrow longitudinal planes, by an oblique ridge extended from the upper-part of the anterior angle, to join with the lower end of the internal angle. To this ridge the ligament ſtretched between the two bones of the leg is connected.

The anterior of the two planes is very narrow above, where the extenſor longus digitorum and extenſor longus pollicis ariſe from it; but is broader below, where it has the print of the nonus Veſalii. The poſterior plane is broad and hollow, giving origin to the larger ſhare of the tibialis poſticus. The internal angle of this bone has a tendinous membrane fixed to it, from which fibres of the flexor digitorum longus take their riſe.

The poſterior ſurface of the fibula is the plaineſt and ſmootheſt, but is made flat above by the ſolæus, and is hollowed below by the flexor pollicis longus. In the middle of this ſurface the canal for the medullary veſſels may be obſerved ſlanting downwards.

I have taken particular notice of the entry and direction of the medullary veſſels of the large bones of the extremities; becauſe, in ſeveral chirurgical caſes, a ſurgeon, who is unacquainted with this, may do miſchief to his patient. Thus, for example, if theſe veſſels are opened very near their entry into the bone, or while they are in the oblique paſſage through it, an obſtinate hæmorrhage may enſue: for the arteries being connected to the bony paſſage, ſtyptics, and other like corrugators, are applied in vain; compreſſing inſtruments cannot be of any ſervice, and ligatures cannot be employed.

There appears to be a particular deſign in the contrivance of theſe canals; thoſe in the os humeri, tibia, and fibula, running obliquely downwards from their external entry; whereas in the radius, ulna, and os femoris, they ſlant upwards, whereby the arteries and nerves, which are ſent into theſe three laſt bones, muſt ſuffer a conſiderable reflection before they come at the cancelli. The reaſon of this diverſity may perhaps be that the arteries which are ſo ſmall within the bones as to have no ſtrong contractile propelling force in their coats, and where they are not aſſiſted by the action of any moving neighbouring organ, ſhould have, at leaſt in their paſſage through the bone, a favourable deſcent for their liquids: which, it is evident, they have in the deſcending oblique paſſages formed for them in the firſt claſs of bones, to wit, the os humeri, tibia, and fibula, which are generally depending; and they alſo moſt frequently acquire the like advantage in the radius, ulna, and os femoris, becauſe the hand, in the moſt natural poſture, is higher than the elbow; and when we ſit or lie, the lower end of the thigh-bone comes to be at leaſt as high raiſed as the upper. In ſtanding and walking, or when the arms are moved, the blood muſt indeed aſcend as it paſſes through the bones of the fore-arm and thigh: but the preſſure of the muſcles, then in action, on the veſſels, before they enter the bones, is ſufficient to compenſate the diſadvantage of their courſe. This reaſoning appears ſtronger by obſerving, that this paſſage is always nearer the upper than the lower ends of theſe bones.

The lower end of the fibula is extended into a ſpongy oblong head, on the inſide of which is a convex, irregular, and oftentimes a ſcabrous ſurface, that is received by the external hollow of the tibia, and ſo firmly joined to it by a very thin intermediate cartilage and ſtrong ligaments, that it can hardly move. Below this, the fibula is ſtretched out into a coronoid proceſs, that is ſmooth, covered with cartilage on its internal ſide, and is there contiguous to the outſide of the firſt bone of the foot, the aſtragalus, to ſecure the articulation. This proceſs, named malleolus externus, being ſituated farther back than the internal malleolus, and in an oblique direction, obliges us naturally to turn the fore-part of the foot outwards. At the lower internal part of this proceſs, a ſpongy cavity for mucilaginous glands may be remarked; from its point ligaments are extended to the aſtragalus, os calcis, and os naviculare, bones of the foot; and from its inſide ſhort ſtrong ones go out to the aſtragalus. On the back-part of it a ſinuoſity is made by the tendons of the peronæi muſcles. When the ligament extended over theſe tendons from the one ſide of the depreſſion to the other is broke, too much ſtretched, or made weak by a ſprain, the tendons frequently ſtart forwards to the outſide of the fibula.

The conjunction of the upper end of the fibula with the tibia is by plain ſurfaces tipped with cartilage, and at its lower end the cartilage ſeems to glue the two bones together, though not ſo firmly in young people, but that the motion at the other end of ſuch a long radius is very obſervable. In old ſubjects it is often obſerved that the two bones of the leg grow together at their lower ends.

The chief uſe of this bone is to afford origin and inſertion to muſcles; the direction of which may be a little altered on proper occaſions, by its upper part ſhuffling backwards and forwards. It likewiſe aſſiſts to make the articulation of the foot more ſecure and firm.

The ends of the tibia and fibula being larger than their middle, a ſpace is here left, which is filled up with ſuch another ligament as I deſcribed extended between the bones of the fore-arm; and which is alſo diſcontinued at its upper part, where the tibialis anticus immediately adheres to the ſolæus and tibialis poſticus; but every where elſe it gives origin to muſcular fibres.

Both ends of this bone are cartilaginous in a ripe child, and aſſume the form of appendices before they are united to its body.

The rotula is the ſmall flat bone ſituated at the fore-part of the joint of the knee. Its ſhape reſembles the common figure of the heart with its point downwards. The anterior convex ſurface of the rotula is pierced by ſeveral holes, into which fibres of the ſtrong ligament that is ſpread over it enter. Behind, its ſurface is ſmooth, covered with cartilage, and divided by a middle convex ridge into two cavities, of which the external is largeſt; and both are exactly adapted to the pulley of the os femoris, on which they are placed in the moſt ordinary unſtraining poſtures of the leg; but when the leg is much bent, the rotula deſcends far down on the condyles; and when the leg is fully extended, the rotula riſes higher, in its upper part, than the pulley of the thigh-bone. The plain ſmooth ſurface is ſurrounded by a rough prominent edge, to which the capſular ligament adheres. The point of the bone below is ſcabrous, where the ſtrong tendinous ligament from the tubercle of the tibia is fixed. The upper horizontal part of this bone is flatted and unequal, where the tendons of the extenſors of the leg are inſerted.

The ſubſtance of the rotula is cellular, with very thin external firm plates: but theſe cells are ſo ſmall, and ſo much bone is employed in their formation, that hardly any bone of its bulk is ſo ſtrong. Beſides, it is covered all over with a thick ligament, to connect its ſubſtance, and is moveable to one ſide or other; conſequently is ſufficiently ſtrong to reſiſt the ordinary actions of the large muſcles that are inſerted into it, or any common external force applied to it; while a fixed proceſs, ſuch as the olecranon, would have been inſufficient to bear the whole weight of our bodies, which frequently falls on it, and would have hindered the rotatory motion of the leg.

Notwithſtanding theſe precautions to preſerve this bone from ſuch injuries, I have ſeen a tranſverſe fracture in it, when, by the report of the patient, and thoſe about him, and by the want of ſwelling, diſcolouring, or other mark of bruiſe or contuſion, it was plain the bone was broken by the violent ſtraining effort of the muſcles. Though my patient recovered the uſe of the joint of the knee, yet I think it reaſonable to believe, that this ſort of fracture is uſually attended with difficulty of motion, after the broken parts of the rotula are re-united; becauſe the callous matter probably extends itſelf into the cavity of the joint, where it either grows to ſome of the parts, or makes ſuch an inequality on the ſurface of this bone, as does not permit it to perform the neceſſary motions on the condyles of the femur.

At the uſual time of birth, the rotula is entirely cartilaginous, and hardly aſſumes a bony nature ſo ſoon as moſt epiphyſes do.

Let us now examine what are the motions of the joint of the knee, and how performed. The two principal motions are, flexion and extenſion. In the former, the leg may be brought to a very acute angle with the thigh, by the condyles of the thigh-bones being round and made ſmooth far backwards. In performing this, the rotula is pulled down by the tibia.

When the leg is to be extended, the rotula is drawn upwards, conſequently the tibia forwards, by the extenſor muſcles, which, by means of the protuberant joint, and of this thick bone with its ligament, have in effect the chord, with which they act, fixed to the tibia at a conſiderable angle, therefore act with advantage; but are reſtrained from pulling the leg farther than to a ſtreight line with the thigh, by the poſterior part of the croſs ligament, that the body might be ſupported by a firm perpendicular column: for at this time the thigh and leg are as little moveable in a rotatory way, or to either ſide, as if they were one continued bone. But when the joint is ſomewhat bent, the rotula is not tightly braced, and the poſterior ligament is relaxed; this bone may therefore be moved a little to either ſide, or with a ſmall rotation in the ſuperficial cavities of the tibia; which is performed by the motion of the external cavity backwards and forwards, the internal ſerving as a ſort of axis.

As one part of the croſs ligament is ſituated perpendicularly, and the poſterior part is ſtretched obliquely from the internal condyle of the thigh outwards, that poſterior part of the croſs ligament prevents the leg's being turned at all inwards; but it could not hinder it from turning outwards almoſt round, was not that motion confined by the lateral ligaments of this joint, which can yield little.

This rotation of the leg outwards is of conſiderable advantage to us in croſſing our legs, and turning our feet outwards, on ſeveral neceſſary occaſions; though it is neceſſary this motion ſhould not be very large, to prevent frequent luxations here.

While theſe motions are performing, the part of the tibia moving immediately on the condyles, is only ſo much as is within the cartilaginous rings, which, by the thickneſs on their outſides, make the cavities of the tibia more horizontal, by raiſing their external ſide where the ſurface of the tibia ſlants downwards; by this means the motions of this joint are more equal and ſteady than they would otherwiſe have been. The cartilages being capable of changing their ſituation a little, are fit for doing this good office in the different motions and poſtures of the member, and alſo contribute to make the motions larger and quicker.

Luxations ſeldom happen in the knee, on account of the very large ſurface of the bones forming the joint of it, and the many ſtrong ligaments connecting them. But theſe very ligaments, the aponeuroſis paſſing over this joint, the quantity of fat and mucilaginous glands neceſſary for lubricating it, make it more ſubject to white-ſwellings, dropſies, and ſuch other diſorders, than any other joint of the body.

The foot, as well as the hand, is divided into three parts, viz. tarſus, metatarſus, and toes; in the deſcription of which, the ſeveral ſurfaces ſhall be named, according to their natural ſituation, viz. the broad of the foot ſhall be called ſuperior; the ſole, inferior; the ſide on which the great toe is, internal; that where the little toe is, external.

The tarſus conſiſts of ſeven ſpongy bones, viz. the aſtragalus, os calcis, naviculare, cuboides, cuneiforme externum, cuneiforme medium, and cuneiforme internum.

The uppermoſt of theſe bones is the aſtragalus. The os calcis is below the aſtragalus, and is conſiderably prominent backwards beyond the other bones to form the heel.

The os naviculare is in the middle of the internal ſide of the tarſus. The os cuboides is the moſt external of the row of four bones at its fore-part. The os cuneiforme externum is placed at the inſide of the cuboid. The cuneiforme medium is between the external and internal cuneiform bones, and the internal cuneiform is put at the internal ſide of the foot.

To avoid repetition, let it be obſerved, that wherever a ridge is mentioned, without a particular uſe aſſigned, a ligament is underſtood to be fixed to it; or where a ſpongy rough cavity, depreſſion, or foſſa is remarked, without naming its uſe, a ligament is inſerted, and mucilaginous glands are lodged; for ſuch will occur in the detail of each of theſe bones.

The upper part of the aſtragalus is formed into a large ſmooth head, which is ſlightly hollowed in the middle, and therefore reſembles a ſuperficial pulley, by which it is fitted to the lower end of the tibia. The internal ſide of this head is flat and ſmooth, to play on the internal malleolus. The external ſide has alſo ſuch a ſurface, but larger, for its articulation with the external malleolus. Round the baſe of this head there is a rough foſſa; and immediately before the head, as alſo below its internal ſmooth ſurface, a conſiderable rough cavity is found.

The lower ſurface of the aſtragalus is divided by an irregular deep rough foſſa, which, at its internal end, is narrow, but gradually widens, as it ſtretches obliquely outwards and forwards.

The ſmooth ſurface covered with cartilage, behind this foſſa, is large, oblong, extended in the ſame oblique ſituation with the foſſa, and concave, for its conjunction with the os calcis.

The back part of the edge of this cavity is produced into two ſharp-pointed rough proceſſes, between which is a depreſſion made by the tendon of the flexor pollicis longus.

The lower ſurface before the foſſa is convex, and compoſed of three diſtinct ſmooth planes. The long one behind, and the exterior or ſhorteſt, are articulated with the heel-bone; while the internal, which is the moſt convex of the three, reſts and moves upon a cartilaginous ligament, which is continued from the calcaneum to the os ſcaphoides. Without this ligament, the aſtragalus could not be ſuſtained, but would be preſſed out of its place by the great weight it ſupports, and the other bones of the tarſus would be ſeparated.

The fore-part of this bone is formed into a convex, oblong, ſmooth head, called by ſome, its proceſs, which is received by the os naviculare. Round the root of this head, eſpecially on the upper ſurface, a rough foſſa may be obſerved.

The aſtragalus is articulated above to the tibia and fibula, which together form one cavity. Though in this articulation the bones have prominences and cavities ſo ſmall, as might allow motions in all directions; yet the flection and extenſion are the moſt conſiderable, the other motions being confined by the malleoli, and by the ſtrong ligaments which go out from the points of theſe proceſſes to the aſtragalus and os calcis. When the foot is bended, ſo far as it is generally when we ſtand, no lateral or rotatory motion is allowed in this joint, for then the head of the aſtragalus is ſunk deep between the malleoli, and the ligaments are tenſe; but when the foot is extended, the aſtragalus can move a little to either ſide, and with a ſmall rotation. By this means the foot is firm, when the weight of the body is to be ſupported on it; and when a foot is raiſed, we are at liberty to direct it more exactly to the place we intend next to ſtep upon. The aſtragalus is joined below to the os calcis.

A conſiderable ſhare of this bone is oſſified in a new-born infant.

The calcaneum is the largeſt bone of the ſeven. Behind, it is formed into a large knob, uſually called the heel; the ſurface of which is rough behind, where the tendo achillis is inſerted into it; and above, it is hollow and ſpongy. Farther forwards, on the upper ſurface of the calcaneum, there is an irregular oblong ſmooth convexity, adapted to the concavity at the back part of the aſtragalus; and beyond this a narrow foſſa is found, which divides it from two ſmall concave ſmooth ſurfaces, that are joined to the fore-part of the aſtragalus. Behind the poſterior of theſe ſmooth ſurfaces, which is the largeſt, a ſmall ſinuoſity is made by the tendon of the flexor digitorum longus; at the fore-part of which a ſmall rough protuberance appears, that gives riſe to the muſculus extenſor digitorum brevis.

The external ſide of this bone is flat, with a ſuperficial foſſa running horizontally, in which the tendon of the muſculus peronæus longus is lodged.

The internal ſide of the heel-bone is hollowed, for lodging the origin of the maſſa cornea Jac. Sylvii, and for the ſafe paſſage of tendons, nerves, and arteries.

Under the ſide of the internal ſmooth concavity, a particular groove is made by the tendon of the flexor pollicis longus; and from the thin protuberance on this internal ſide, the cartilaginous ligament that ſupports the aſtragalus, goes out to the os naviculare; on which ligament,

ment, and on the edge of this bone to which it is fixed, the groove is formed for the tendon of the flexor digitorum profundus.

The lower ſurface of this bone is preſſed flat at the back part, by the weight of the body; and immediately before this plane there are two tubercles, from the internal of which the muſculus abductor pollicis, flexor digitorum ſublimis, as alſo part of the aponeuroſis plantaris, and of the abductor minimi digiti, have their origin; and the other part of the abductor minimi digiti, and aponeuroſis plantaris, riſes from the external.

Before theſe protuberances this bone is concave, for lodging the flexor muſcles; and at its fore part we may obſerve a rough depreſſion, from which, and a tubercle behind it, the ligament goes out that prevents this bone from being ſeparated from the os cuboides.

The fore-part of the os calcis is formed into an oblong pulley-like ſmooth ſurface, which is circular at its upper external end, but is pointed below. This ſmooth ſurface is fitted to the os cuboides.

Though the ſurfaces by which the aſtragalus and os calcis are articulated, ſeem properly adapted for motion; yet the very ſtrong ligaments by which theſe bones are connected, prevent it, and render the os calcis, this principal part of our baſe, which reſts on the ground, firm.

Great part of the heel-bone is oſſified at the ordinary time of birth, and the large knob appears afterwards in form of an epiphyſe.

The os naviculare is ſomewhat circular. It is formed into an oblong concavity behind, for receiving the anterior head of the aſtragalus. On the upper ſurface there is a rough foſſa. Below, the os naviculare is very unequal and rough, but hollow for the ſafety of the muſcles. On its inſide riſes out a large knob, from which the abductor pollicis takes in part its origin, the tendon of the tibialis poſticus is inſerted into it, and to it two remarkable ligaments are fixed; the firſt is the ſtrong one, already mentioned, which ſupports the aſtragalus; the ſecond is ſtretched from this bone obliquely croſs the foot, to the metatarſal bones of the middle toe, and of the toe next to the little one.

On the outſide of the os naviculare there is a ſemicircular ſmooth ſurface, where it is joined to the os cuboides. The fore-part of this bone is all covered with cartilage, and is divided into three ſmooth planes, fitted to the three oſſa cuneiformia.

The os naviculare and aſtragalus are joined as a ball and a ſocket, and the naviculare moves in all directions in turning the toes inwards, or in raiſing or depreſſing either ſide of the foot, though the motions are conſiderably ſtrained by the ligaments which connect this to the other bones of the tarſus.

A weakneſs of theſe ligaments frequently cauſes an unnatural turn of the fore-part of the foot inwards.

The os naviculare is entirely cartilaginous in a new-born infant.

The os cuboides is a very irregular cube. Behind it is formed into an ablong unequal concavity, ſuited to the fore-part of the os calcis. On its internal ſide, there is a ſmall ſemicircular ſmooth cavity, to join the os naviculare. Immediately before which, an oblong ſmooth plane is made by the os cuneiforme externum. Below this the bone is hollow and rough. On the internal ſide of the lower ſurface a round protuberance and foſſa are to be ſeen, where the muſculus adductor pollicis has its origin.

On the external ſide of the ſame ſurface, there is a round knob, covered with cartilage; immediataly before which, a ſmooth foſſa may be ſeen, in which the tendon of the peronæus primus runs obliquely croſs the foot; and on the knob, the thin flat cartilage proper to this muſcle plays; inſtead of which a bone is ſometimes found: more externally than the knob, a rough hollow is made, for the ſtrong ligaments ſtretched betwixt this bone and the os calcis. Before, the ſurface of the os cuboides is flat, ſmooth, and ſlightly divided into two planes, for ſuſtaining the os metatarſi of the little toe, and of the toe next to it.

The form of the back part of the os cuboides, and the ligaments connecting the joint there with the os calcis, both concur in permitting little motion in this part.

The oſſification of this bone is hardly begun at the birth.

The os cuneiforme externum, is much of the ſhape of a wedge, being broad and flat above, with long ſides running obliquely downwards, and terminating in a ſharp edge. The upper ſurface of this bone is an oblong ſquare. The one behind is nearly a triangle, but not compleat at the inferior angle, and is joined to the os naviculare. The external ſide is an oblong ſquare divided as it were by a diagonal; the upper half of it is ſmooth, for its conjunction with the os cuboides: the other is a ſcabrous hollow, and in its ſuperior anterior angle a ſmall ſmooth impreſſion is made by the os metatarſi of the toe next to the little one. The internal ſide of this bone is alſo quadrangular; with the fore-part of its edge made flat and ſmooth by the os metatarſi of the toe next to the great one, and the back-part is alſo flat and ſmooth where the os cuneiforme medium is contiguous to it. The fore-part of this bone is an oblong triangle, for ſuſtaining the os metatarſi of the middle toe.

The os cuneiforme medium, or minimum, is more exactly the ſhape of a wedge than the former. Its upper part is ſquare; its internal ſide has a flat ſmooth ſurface above and behind, for its conjunction with the following bone; with a ſmall rough foſſa below; and a conſiderable part of it is rough and hollow.

The external ſide is ſmooth and a little hollowed, where it is contiguous to the laſt deſcribed bone. Behind, this bone is triangular, where it is articulated with the os naviculare; and it is alſo triangular at its fore-part, where it is contiguous to the os metatarſi of the toe next to the great one.

The os cuneiforme maximum or internum, differs from the two former in its ſituation, which is more oblique than theirs. Beſides, its broad thick part is placed below, and the ſmall thin point is above and outwards; while its under broad ſurface is concave, for allowing a ſafe paſſage to the flexors of the great toe. The ſurface of this os cuneiforme behind, where it is joined to the os naviculare, is hollow, ſmooth, and of a circular figure below, but pointed above. The external ſide conſiſts of two ſmooth and flat ſurfaces, whoſe direction is nearly at right angles with each other. With the poſterior, that runs obliquely from below forwards and upwards, the os cuneiforme minimum is joined; and with the anterior, whoſe direction is longitudinal, the os metatarſi of the toe next to the great one is connected. The fore-part of this bone is ſemilunar, but flat and ſmooth, for ſuſtaining the os metatarſi of the great toe. The internal ſide is ſcabrous, with two remarkable tubercles below, from which the muſculus abductor pollicis riſes, and the tibialis anticus is inſerted into its upper part.

The three cuneiform bones are all ſo ſecured by ligaments, that very little motion is allowed in any of them, and they are cartilaginous in a fœtus in nine months.

Theſe ſeven bones of the tarſus, when joined, are convex above, and leave a concavity below, for ſafely lodging the ſeveral muſcles, tendons, veſſels, and nerves that lie in the ſole of the foot.

In the recent ſubject, their upper and lower ſurfaces are covered with ſtrong ligaments which firmly adhere to them, and all the bones are ſo tightly connected by theſe and the other ligaments, which are fixed to the rough ridges and foſſæ, that, notwithſtanding the many ſurfaces covered with cartilages, ſome of which are of the form of the very moveable articulations, no more motion is here allowed, than only to prevent too great a ſhock of the fabric of the body in walking, leaping, &c. by falling on too ſolid a baſe; which, if it was one continued bone, would alſo be much more liable to be broken: and, in order to make our foot accommodate itſelf to the ſurface we tread on, by becoming more or leſs hollow, or by raiſing or depreſſing either ſide of it.

Sprains occaſion here, as well as in the wriſt, great pain and obſtinate tumours, which frequently cauſe carious bones.

The metatarſus is compoſed of five bones, which agree in their general characters with the metacarpal bones; but may be diſtinguiſhed from them by the following marks: 1. They are longer, thicker, and ſtronger. 2. Their anterior round ends are not ſo broad, and are ſmaller in proportion to their baſes. 3. Their bodies are ſharper above and flatter on the ſides, with their inferior ridge inclined more to the outſide. 4. The tubercles at the lower parts of the round head are larger.

The firſt or internal metatarſal bone is eaſily diſtinguiſhed from the reſt by its thickneſs.

That next to it is the longeſt, and with its ſharp edge almoſt perpendicular. The others are ſhorter and more oblique, as their ſituation is more external.

The os metatarſi pollicis is by much the thickeſt and ſtrongeſt, as having much the greateſt weight to ſuſtain. Its baſe is oblong, irregularly concave, and of a ſemilunar figure to be adapted to the os cuneiforme maximum.

The inferior edge of this baſe is a little prominent and rough, where the tendon of the peronæus primus muſcle is inſerted. On its outſide an oblique circular depreſſion is made by the ſecond metatarſal bone. Its round head has generally on its fore-part a middle ridge, and two oblong cavities, for the oſſa ſeſamoidea; and on the external ſide a depreſſion is made by the following bone.

The os metatarſi of the ſecond toe, is the longeſt of the five, with a triangular baſe ſupported by the os cuneiforme medium and the external ſide produced into a proceſs; the end of which is an oblique ſmooth plane, joined to the os cuneiforme externum.

Near the internal edge of the baſe, this bone has two ſmall depreſſions, made by the os cuneiforme maximum, between which is a rough cavity.

Farther forwards we may obſerve a ſmooth protuberance, joined to the foregoing bone. On the outſide of the baſe are two oblong ſmooth ſurfaces, for its articulation with the following bone; the ſuperior ſmooth ſurface being extended longitudinally, and the inferior perpendicularly; between which there is a rough foſſa.

The os metatarſi of the middle toe, is the ſecond in length. Its baſe, ſupported by the os cuneiforme externum, is triangular, but ſlanting outwards, where it ends in a ſharp-pointed little proceſs, and the angle below is not completed.

The internal ſide of this baſe is adapted to the preceding bone; and the external ſide has alſo two ſmooth ſurfaces covered with cartilage, but of a different figure; for the upper one is convave, and, being round behind, turns ſmaller as it advances forwards; and the lower ſurface is ſmall, ſmooth, convex, and very near the edge of the baſe.

The os metatarſi of the fourth toe, is almoſt as long as the former, with a triangular ſlanting baſe joined to the os cuboides, and made round at its external angle, having one hollow ſmooth ſurface on the outſide, where it is preſſed upon by the following bone, and two on the internal ſide, correſponding to the former bone; behind which is a long narrow ſurface impreſſed by the os cuneiforme externum.

The os metatarſi of the little toe, is the ſhorteſt, ſituated with its two flat ſides above and below, and with the ridges laterally. The baſe of it, part of which reſts on the os cuboides, is very large, tuberous, and produced into a long-pointed proceſs externally, where part of the abductor minimi digiti is fixed; and into its upper part the peronæus ſecundus is inſerted. Its inſide has a flat conoidal ſurface, where it is contiguous to the preceding bone.

When we ſtand, the fore-ends of theſe metatarſal bones, and the os calcis, are our only ſupporters; it is therefore neceſſary they ſhould be ſtrong, and ſhould have a confined motion.

The bones of the toes reſemble thoſe of the thumb and fingers; particularly the two of the great toe are formed exactly as the two laſt of the thumb; only their poſition, in reſpect of the other toes, is not oblique; and they are proportionally much ſtronger, becauſe they are ſubjected to a greater force: they ſuſtain the force with which our bodies are puſhed forward by the foot behind at every ſtep we make; and on them principally the weight of the body is ſupported, when we are raiſed on our tiptoes.

The three bones in each of the other four toes, when compared to thoſe of the fingers, differ from them in theſe particulars. They are leſs, and ſmaller in proportion to their lengths. Their baſes are much larger than their anterior ends: their bodies are narrower above and below, and flatter on the ſides. The firſt phalanx is proportionally much longer than the bones of the ſecond and third, which are very ſhort.

Of the four, the toe next to the great one, has the largeſt bones in all dimenſions, and more externally the toes are leſs. The little toe, and often that next to it, have the ſecond and third bones intimately united into one; which may perhaps be owing to their little motion, and the great preſſure they are ſubjected to.

The toes are very uſeful to us in walking; for, when the ſole is raiſed, they bring our body, with its center of gravity, perpendicular to the advanced foot.

The bones of the metatarſus and toes, are in the ſame condition in children as thoſe of the metacarpus and fingers.

The bones now remaining to complete the deſcription of the ſkeleton, are the ſmall ones, found at the joints of the fingers and toes, and in ſome other parts, called oſſa ſeſamoidea, which are of various figures and ſizes, though they are generally ſaid to reſemble the ſeed of the ſeſamum. They ſeem to me nothing elſe than the ligaments of the articulations or the firm tendons of ſtrong muſcles, or both, become bony, by the compreſſion which they ſuffer.

Thus the ſeſamoid bones at the beginning of the gaſtrocnemii muſcles, are evidently compoſed of the tendinous fibres only. Theſe, at the firſt joint of the great toe, are as plainly the ſame continued ſubſtance with the ligaments and the tendons of the adductor, flexor, brevis, and abductor. That which is ſometimes double at the ſecond joint of that toe, is part of the capſular ligament; and if we enumerate the other ſeſamoid bones that are at any time found, we may obſerve all of them formed in this manner. Their number, figure, ſituation, and magnitude, are too uncertain to inſiſt on the differences of each; and therefore I ſhall only in general remark,

1. That where-ever the tendons and ligaments are firmeſt, the actions of the muſcles ſtrongeſt, and the compreſſion greateſt, there ſuch bones are moſt uſually found.

2. That, cæteris paribus, the older the ſubject is in which they are ſought, their number is greater, and their ſize larger.

3. The more labour any perſon is accuſtomed to, he has, cæteris paribus, the moſt numerous and largeſt oſſa ſeſamoidea.

But as the two at the firſt joint of the great toe are much larger than any other, are early formed, and are ſeldom wanting in an adult, we may reaſonably judge, that beſides the more forcible cauſe of their formation, there ſhould alſo be ſome particular advantage neceſſary at this place, rather than elſewhere, which may poſſibly be, to allow the flexor muſcles to ſend their tendons along this joint, ſecure from compreſſion in the hollow between the two oblong ſeſamoid bones; while by removing theſe tendons from the center of motion, and giving them the advantage of an angle at their inſertion, the force of the muſcles is increaſed, and therefore the great ſuperincumbent weight of our body in progreſſion is raiſed with greater eaſe.

Of the Marks of the Female Skeleton.

I think it neceſſary to ſubjoin the diſtinguiſhing marks of the male and female ſkeletons, and have choſen to illuſtrate them principally in the latter; becauſe women having a more delicate conſtitution, and affording lodging and nouriſhment to their tender fœtuſes, till they have ſufficient ſtrength and firmneſs to bear the injuries of the atmoſphere, and contact of other more ſolid ſubſtances, their bones are frequently incomplete, and in ſome parts of the body always of a make different from thoſe of the robuſt male; which agree to the deſcription already given, unleſs where the proper ſpecialities of the female were particularly remarked; which could not be done in all places where they occur, without perplexing the reader.

The cauſes of the following ſpecialities of the female bones may be reduced to theſe three: 1. A weak lax conſtitution. 2. A ſedentary unactive life, increaſing that conſtitution. 3. A proper frame for being mothers.

The bones of women in proportion to their length, are ſmaller than thoſe of men; becauſe the force of their muſcles is not ſo great, nor is ſuch ſtrong external force applied to them to prevent their ſtretching out in length.

The depreſſions, ridges, ſcabrous ſurfaces, and other inequalities made by the muſcles, are not ſo conſpicuous in them; their muſcles being neither ſo thick nor ſtrong, nor ſo much employed, to make ſuch ſtrong prints on their bones.

Their os frontis is more frequently divided by a continuation of the ſagittal ſuture, which depends on the firſt and ſecond general cauſes aſſigned above, for the ſpecialities in their bones.

Their clavicles are leſs crooked, becauſe their arms have been leſs forcibly pulled forwards, which, in our European women, eſpecially thoſe of diſtinction, is more hindered by their garb.

Their ſternum is more raiſed by long cartilages below, that the thorax might be there widened in ſome proportion to what it is ſhortened by the preſſure upon the diaphragm, when they are with child.

The defect of bone, or the hole in the middle of the ſternum, is more frequently found in them, to allow, as ſome imagine, the paſſage of the mammary veſſels; but, in my opinion, this is owing to a lax conſtitution, by which the oſſification is not ſo ſoon compleated as in men, where the action of the ſolids is vigorous, and the circulation of the fluids is briſk; for a much ſmaller hole might have anſwered this purpoſe; and the branches of the internal mammary veſſels which are ſent to the external parts of the thorax, do not paſs here, but between the cartilages of the ribs, before theſe are joined to the ſternum.

The cartilago xiphoides is more frequently bifurcated in women than men, for the reaſon aſſigned in the preceding paragraph, viz. a leſs forcible power of oſſification.

The ſuperior cartilages of the ribs ſooner oſſify, to ſupport the weight of the mammæ.

The middle cartilages are flatter and broader, by the weight of the breaſts.

The inferior cartilages are longer, for enlarging the cheſt.

Weak women, who have borne many children when young, often have the vertebræ of their back bended forwards, and their ſternum depreſſed, or become round-ſhouldered and flat breaſted (*a*) by the preſſure and weight of the impregnated uterus, and by the ſtrong action of the abdominal muſcles.

The os ſacrum is broader and turned much more backwards, for enlarging the pelvis.

The os coccygis is more moveable, and much leſs bended forwards, to facilitate the birth.

The oſſa ilium are more hollow, and more reflected outwards, and conſequently further removed from each other, in order to widen the lower part of their abdomen, and for the better ſupport of the impregnated uterus.

The ridge on the upper part of the os pubis is larger in women that have borne children, being extended by the ſtrong action of the muſculi recti abdominis.

The cartilage between the two oſſa pubis, eſpecially in women who have borne children, is thicker than in men, by which the pelvis is more capacious in females.

The conjoined ſurfaces of the oſſa pubis, and of the oſſa innominata and ſacrum, are leſs; the angle under the ſymphyſis of the oſſa pubis, is much larger, and the arches formed below and behind by the oſſa ilium and iſchium, are wider, which, with the ſtraighter os ſacrum, and more diſtant tubera iſchii, leave a larger paſſage for the excluſion of the child in birth.

The great tuberoſity of the oſſa iſchium is flatter in women than in men, becauſe it is more preſſed upon in the ſedentary life, which females are generally accuſtomed to.

The pelvis of women being wider, the articulations of their thigh-bones muſt be farther removed from each other, and therefore a larger ſpace is left for the procreation and birth of children (*b*); which diſtance of the thighs may be one reaſon why women in running generally ſhuffle more from one ſide to the other than men, to preſerve

(*a*) Cheſelden's Anatomy, book i. chap. 3.

(*b*) Albin. De oſſib. ſect. 339.

the center of gravity of their bodies from falling too far to a ſide of the joint of the thigh that ſupports them when the other is raiſed, which would endanger their falling.

The ANATOMY *of the* HUMAN NERVES.

1. The numerous turns made by the carotid and vertebral arteries before they paſs through the dura mater, theſe arteries having neither ſwelling muſcles nor preſſure of the atmoſphere to aſſiſt the courſe of the blood in them after they enter the ſkull, and their diviſion into innumerable communicating branches in the pia mater, and its proceſſes, ſhew, that the liquors muſt move more ſlowly and equally in them, than in moſt other parts of the body.

2. By the aid of injections and microſcopes, the very minute branches of theſe veſſels are diſcovered to go from the pia mater into the cortex, cineritious, or aſhy-coloured part of the cerebrum, cerebellum, and ſpinal marrow; whereas we can only ſee longitudinal veſſels, without numerous ramifications or reticular plexuſes, in the white medullary ſubſtance of theſe parts.

3. The continuity of the cortex with the medulla of the encephalon and ſpinal marrow is diſcernible with the naked eye, and is more diſtinctly ſeen with the aſſiſtance of a microſcope.

4. In diſſecting the brain and cerebellum, we obſerve the ſmall beginnings of the medulla proceeding from the cortex, and trace its gradual increaſe by the addition of more ſuch white ſubſtance coming from the cortex.

5. Both theſe ſubſtances are very ſucculent; for being expoſed to the air to dry, they loſe more of their weight than moſt other parts of the body do.

6. In ſeveral places we may obſerve the medulla to be compoſed of fibres laid at each other's ſides.

7. The medullary ſubſtance is employed in forming the white fibrous cords, which have now the name of nerves appropriated to them. Within the ſkull we perceive the nerves to be the medullary ſubſtance continued; and the ſpinal marrow is all employed in forming nerves.

8. The common received opinion concerning the riſe of the nerves, founded on a ſuperficial inſpection of thoſe parts, is, that the nerves are propagated from that ſide of the encephalon, at which they go out of the ſkull. But it has been remarked, after a more ſtrict enquiry, and preparing the parts by maceration in water, that the medullary fibres decuſſate or croſs each other in ſome parts of the medulla; as for example, at the corpus annulare, and beginning of the ſpinal marrow: and practical obſervators have related ſeveral examples of people whoſe brain was hurt on one ſide, while the morbid ſymptom, palſy, appeared on the other ſide of the body, of which I have ſeen ſome inſtances; and experiments made on brutes have confirmed theſe obſervations; it has therefore been thought, that the

nerves had their riſe from that ſide of the encephalon, which is oppoſite to their egreſs from the ſkull. Nevertheleſs, it may ſtill be ſaid, that this laſt opinion is not fully demonſtrated, becauſe a decuſſation in ſome parts is not a proof that it obtains univerſally; and if there are examples of palſy of the ſide oppoſite to where the leſion of the brain was, there are alſo others, where the injury done to the brain and the palſy were both on the ſame ſide.

9. The nerves are compoſed of a great many threads lying parallel or nearly parallel to each other at their exit from the medulla.

This fibrous texture is evident at the origin of moſt of the nerves within the ſcull; and in the cauda equina of the ſpinal marrow, we can divide them into ſuch ſmall threads, that a good eye can hardly perceive them; but theſe threads, when obſerved with a microſcope, appear each to be compoſed of a great number of ſmaller threads.

10. We know not how ſmall one of theſe fibrils of the nerves is; but when we conſider that even the moſt minute part of the body is ſenſible, and that this muſt depend on the nerves (which all conjoined would not make a cord of an inch diameter) being divided into branches or filaments to be diſperſed through all theſe minute parts, we muſt be convinced that the nervous fibrils are very ſmall. From the examination of the minimum viſibile, it is demonſtrated, that each fibre in the retina of the eye, or expanded optic nerve, cannot exceed the ſize of the 32,400 part of a hair.

11. The medullary ſubſtance, of which the nervous fibrils are compoſed, is very tender, and would not be able to reſiſt ſuch forces as the nerves are expoſed to within the bones, nor even the common force of the circulating fluids, were not the pia mater and tunica arachnoides continued upon them; the former giving them firmneſs and ſtrength, and the latter furniſhing a cellular coat to connect the threads of the nerves, to let them lie ſoft and moiſt, and to ſupport the veſſels which go with them. It is this cellular ſubſtance that is diſtended when air is forced through a blow-pipe thruſt into a nerve, and that makes a nerve appear all ſpongy, after being diſtended with air till it dries; the proper nervous fibrils ſhrivelling ſo in drying, that they can hardly be obſerved.

13. Theſe coats would not make the nerves ſtrong enough to bear the ſtretching and preſſure they are expoſed to in their courſe to the different parts of the body; and therefore, where the nerves go out at the holes in the cranium and ſpine, the dura mater is generally wrapped cloſely round them, to collect their diſgregated fibres into tight firm cords; and that the tenſion which they may happen to be expoſed to, may not injure them before they have got this additional coat, it is firmly fixed to the ſides of the holes in the bones through which they paſs.

13. The nervous cords thus compoſed of nervous fibrils, cellular coat, pia and dura mater, have ſo many blood-veſſels, that after their arteries only are injected, the whole cord is tinged of the colour of the injected liquor; and if the injection is puſhed violently, the cellular ſubſtance of the nerves is at laſt diſtended with it.

14. A nervous cord, as above deſcribed, has very little elaſticity, when compared with ſeveral other parts of the body. When cut out of the body, it does not become obſervably ſhorter, while the blood-veſſels contract three-eights of their length.

15. Nerves are generally lodged in a cellular or fatty ſubſtance, and have their courſe in the interſtices of muſcles, and other active organs, where they are guarded from preſſure; but in ſeveral parts they are ſo placed, as if it was intended that they ſhould there ſuffer the vibrating force of arteries, or the preſſure of the contracting fibres of muſcles.

16. The larger cords of the nerves divide into branches as they go off to the different parts; the branches being ſmaller than the trunk from which they come, and making generally an acute angle where they ſeparate.

17. In many places, different nerves unite into one cord, which is generally larger than any of the nerves which form it.

18. Several nerves, particularly thoſe diſtributed to the bowels, after ſuch union, ſuddenly form a hard knot conſiderably larger than all the nerves of which it is made. Theſe knots were called corpora olivaria, and are now generally named ganglions.

19. The ganglions have thicker coats, more numerous and larger blood-veſſels than the nerves, therefore they appear more red and muſcular. On diſſecting the ganglions, fibres are ſeen running longitudinally in their axes, and other fibres are derived from their ſides in an oblique direction to the longitudinal ones.

20. In general, numerous ſmall nerves, which conjunctly are not equal to the ſize of the ganglion, are ſent out from it, but with a ſtructure no way different from that of other nerves.

21. The nerves ſent to the organs of the ſenſes, loſe there their firm coats, and terminate in a pulpy ſubſtance. The optic nerves are expanded into the ſoft tender webs, the retinæ. The auditory nerve has hardly the conſiſtence of mucus in the veſtibulum, cochlea, and ſemicircular canals of each ear. The papillæ of the noſe, tongue, and ſkin, are very ſoft.

22. The nerves of muſcles can alſo be traced till they ſeem to loſe their coats by becoming very ſoft; from which, and what we obſerved of the ſenſatory nerves, there is reaſon to determine, that the muſcular nerves are alſo pulpy at their terminations, which we cannot indeed proſecute by diſſection.

23. It appears neceſſary, that the extremities of the nerves ſhould continue in this ſoft flexible ſtate, in order to perform their functions right: for, in proportion as parts become rigid and firm by age, or any other cauſe, their ſenſibility is impaired, and the motions are more difficultly performed.

24. Though the fibres in a nervous cord are firmly connected, and different nerves frequently join into one trunk, or into the ſame ganglion; yet the ſenſation of each part of the body is ſo very diſtinct, and we have ſo much the power of moving the muſcles ſeparately, that, if the nerves are principal agents in theſe two functions, which I ſhall endeavour to prove they are, we have reaſon to imagine that

there is no union, confuſion, or immediate communication of the proper nervous fibrils, but that each fibre remains diſtinct from its origin to its termination.

25. Changes produced any way upon the coats of the nerves, cannot however fail of affecting the nervous fibrils. The cellular ſubſtance may be too full of liquor, or may not ſupply enough; the liquor may not be of a due conſiſtence, or it may be preternaturally obſtructed and collected. The pia or dura mater may be too tenſe, or too lax; their veſſels may be obſtructed; their proper nerves may be violently irritated, or loſe their power of acting; and many other ſuch changes may happen, which will not only occaſion diſorders in particular nerves, but may be a cauſe of the ſympathy ſo frequently obſerved among the nerves; which is ſo neceſſary to be attentively regarded in many diſeaſes, in order to diſcover their true ſtate and nature, that, without this knowledge, very dangerous miſtakes in the practice of phyſic and ſurgery may be made.

26. Many experiments and obſervations concur in proving, that when nerves are compreſſed, cut, or any other way deſtroyed, the parts ſerved by ſuch nerves, farther from the head or ſpine than where the injuring cauſe has been applied, have their ſenſations, motions, and nouriſhment weakened or loſt, while no ſuch effects are ſeen in the parts nearer to the origin of thoſe nerves; and in ſuch experiments where the cauſe impeding the nerves to exert themſelves could be removed, and the ſtructure of the nerves not injured; as for example, when a ligature made upon a nerve, and ſtopping its influence has been taken away, the motion and ſenſation of the parts ſoon were reſtored; from which it appears, that the nerves are principal inſtruments in our ſenſations, motions, and nouriſhment; and that this influence of the nerves is not inherent in them, unleſs the communication between theſe cords and their origin is preſerved.

This is a juſt concluſion, notwithſtanding that ſometimes, upon cutting a nerve, the effects abovementioned have been felt for a ſhort time; but afterwards the perſon was ſenſible of no numbneſs or immobility; for wherever this is ſaid to have happened, the cut nerve was only one of ſeveral which were ſent to the member; the want of whoſe influence was felt no longer, than till the habit was acquired of performing the functions eaſily by the other nerves.

Nor is it an objection of greater force, that ſometimes when a ligature is drawn very hard upon a nerve, and then is taken away, the nerve never again recovers its influence upon the parts it is diſtributed to beyond the ligature, but is of as little effect as if it had been cut through; which is to ſay, that its texture has been altered beyond recovery. The ſame thing may be obſerved by tying a thread tight round a tender twig of any vegetable; it decays.

27. Experiments and obſervations alſo ſhew, that when parts of the encephalon, or ſpinal marrow, have been irritated, compreſſed, or deſtroyed, the parts of the body, whoſe nerves had their origin from ſuch affected parts of the encephalon, or ſpinal marrow, became convulſed, paralytic, inſenſible, or waſted; and in ſuch caſes where

the injuring cauſe could be removed from the origin of the nerves, the morbid ſymptoms obſerved in the parts to which theſe nerves were diſtributed, went off upon the removal of that cauſe. From which it may be reaſonable to conclude, that the nerves muſt not only have a communication with their origin, but that the influence they have upon the parts they are diſtributed to, depends on the influence which they derive from the medulla encephali and ſpinalis.

28. Though the ſpinal marrow has its own veſſels and cineritious ſubſtance which aſſiſts to form its medulla; yet a very large ſhare of the medullary ſubſtance within the ſpine, is derived from the encephalon, whoſe medulla oblongata deſcends from the head, and the influence of the ſpinal marrow on its nerves depends in a great meaſure on this medulla oblongata of the head. Hence an injury done to any part of the ſpinal marrow, immediately affects all the parts whoſe nerves have their origin below where the injuring cauſe is applied. A luxation of a vertebra in the loins makes the lower extremities ſoon paralytic; a tranſverſe ſection of the medulla, at the firſt vertebra of the neck, ſoon puts an end to life.

29. If ſuch effects are produced by ſuch cauſes, in us and other creatures living in nearly the ſame circumſtances as we do, the concluſions already made muſt be good, notwithſtanding examples of children and other creatures being born without brains or ſpinal marrow; or notwithſtanding the brains of adult creatures can be much changed in their texture by diſeaſes; and that tortoiſes, and ſome other animals, continue to move a conſiderable time after their heads are cut off. We may not know the particular circumſtances requiſite or neceſſary to the being or well being of this or that particular creature, nor be able to account for a great many phænomena; but we muſt believe our eyes in the examination of facts; and if we ſee conſtantly ſuch conſequences from ſuch actions, we cannot but conclude the one to be the cauſe, and the other the effect. It would be as unjuſt to deny the concluſions made in the three preceding articles, becauſe of the ſeemingly preternatural phænomena mentioned at the beginning of this, as it would be to deny the neceſſity of the circulation of the blood in us and moſt quadrupeds; becauſe a frog can jump about, or a tortoiſe can walk long after all the bowels of its thorax and abdomen are taken out, or becauſe the different parts of a worm crawl after it has been cut into ſeveral pieces. It is therefore almoſt univerſally allowed, that the nerves are principal inſtruments in our ſenſations, motion, and nouriſhment; and that the influence which they have is communicated from their origin, the encephalon and medulla ſpinalis. But authors do not agree about the manner in which this influence is communicated, or in what way nerves act to produce theſe effects.

30. It is alledged by ſome, that the nervous fibres are all ſolid cords, acting by elaſticity or vibration; others maintain, that thoſe fibres are ſmall pipes conveying liquors, by means of which their effects are produced.

31. Thoſe who think the nervous fibres ſolid, raiſe ſeveral objections to the other doctrine, which I ſhall conſider afterwards; and en-

deavour to ſhew the fitneſs of their own doctrine to account for the effects commonly obſerved to be produced by the nerves.

The objects of the ſenſes, ſay they, plainly make impulſes on the nerves of the proper organs, which muſt ſhake the nervous fibrils; and this vibration muſt be propagated along the whole cord to its other extremity or origin, as happens in other tenſe ſtrings; and theſe vibrations being differently modified, according to the difference of the object, and its different application, produce the different ideas we have of objects.

32. The firſt objection is, to this account of ſenſation, that nerves are unfit for vibrations, becauſe their extremities, where objects are applied to them, are quite ſoft and pappy, and conſequently not ſuſceptible of the vibrations ſuppoſed; and if there could be any little tremor made here by the impulſe of objects, it could not be continued along the nervous cord, becauſe the cellular ſubſtance by which each particular fibre is connected to the neighbouring ones, and the fatty ſubſtance in which the nervous cord is immerſed, would ſoon ſtifle any ſuch vibratory motion.

The ſecond objection to this doctrine is, that ſuppoſing the nerves capable of vibrations by the impreſſions of objects, theſe vibrations would not anſwer the deſign: for if what we know of other vibrating ſtrings, to wit, that their tone remains the ſame, unleſs their texture, length, or tenſion is altered, and that different ſubſtances ſtriking them, do no more than make the ſound higher or lower: if theſe properties are to be applied to nerves, it will then follow, that the ſame nerve would conſtantly convey the ſame idea, with no other variety than of its being weaker and ſtronger, whatever different objects were applied to it, unleſs we ſuppoſed the nerve changed in its texture, length, or tenſion, each time a different object is applied; which, it is preſumed, no body will undertake to prove does happen.

Again, if ever ſuch a variety of vibrations could be made, our ſenſations would ſtill be confuſed and indiſtinct; becauſe the tremulous, nervous fibre being firmly connected and contiguous to ſeveral other fibres of the ſame cord, would neceſſarily ſhake them too, by which we ſhould have the notion of the object as applied at all the different parts where the extremities of theſe fibres terminate.

33. In whatever way thoſe who favour the doctrine of ſolid nerves pleaſe to apply the elaſticity of nerves to the contraction of muſcles, their adverſaries inſiſt, that nerves are too weak to reſiſt ſuch weights as the muſcles ſuſtain; they would certainly break, eſpecially as they are, in a great meaſure, if not wholly, deprived of their ſtrong coats before they come to the part of the muſcle they are immediately to act upon. The nerves being found to have little or no elaſticity to ſhorten themſelves, ſhews them entirely unfit for ſuch an office as this, of contracting muſcles in the way propoſed of their acting by elaſticity; and when a nerve is viewed with a microſcope, while the muſcles it ſerves are in action, no contraction or motion is obſerved in it; nay, if they were elaſtic, they would equally exert their power of contracting muſcles nearer to their origin, as well as farther from it,

when they were put into contraction or vibration, by irritation of any part of them. The former however, does not happen.

34. It is ſaid, as a further objection againſt either motion or ſenſation being owing to the elaſticity of the nerves, that if this doctrine was true, the ſenſations would be more acute, and the contractions of muſcles would be greater and ſtronger, when the parts become firmer and more rigid by age; for then their elaſticity is increaſed: but, on the contrary, it appears, that the ſenſations are then blunted, and muſcular contraction becomes leſs and weaker.

35. If the nerves were admitted to be elaſtic, and to communicate a ſpringy force to all the parts they are diſtributed to, they might appear neceſſary in this view to aſſiſt the application of the nutritious particles of the fluids to the ſides of the veſſels which theſe particles were to repair; and ſo far might, in ſome meaſure, account for the ſhare which nerves are thought to have in nutrition: but if we cannot make uſe of elaſticity in the other two functions, ſenſation and motion, we muſt alſo endeavour to find out ſome other way for the nerves to act in nutrition; which will be done afterwards.

36. Having thus ſtated the reaſons for and againſt the nerves acting as ſolid ſtrings, let us alſo relate the arguments for nerves being pipes, and the objections to this doctrine.

A ſtrong argument of thoſe who ſuppoſe the nerves to be tubes conveying liquors, is the ſtrong analogy of the brain and nerves to other glands of the body and their excretories, where a manifeſt ſecretion of liquor is made in the glands, to be conveyed by the excretories to the proper places in which it ought to be depoſited: they think that the vaſcular texture of the cortex of the encephalon and ſpinal marrow, the continuation of the cortex in forming the medullary ſubſtance, the fibrous texture, and ſucculent ſtate of this medulla, and its being wholly employed to form the nerves, where the fibrous texture is evident; all theſe things, ſay they, conſpire to ſhew ſuch a ſtrong analogy between theſe parts and the other glands of the body, as to carry a conviction that there is a liquor ſecreted in the encephalon and the ſpinal marrow, to be ſent out by the nerves to the different parts of the body.

37. To this argument in favour of liquor conveyed in the nerves from the analogy of the glands, the following objections are raiſed: 1ſt. Other glands, it is ſaid, have their excretories collected into a few large pipes, and not continued in ſo great a number of ſeparate pipes, as far as the places where the liquors are depoſited; which laſt muſt be the caſe, if the nerves are the excretories of the glandular brain. 2dly. We ſee the cavities, and can examine the liquors in the excretories of other glands much ſmaller than the brain; which cannot be done in the nerves. 3dly. If the nerves were pipes, they would be ſo ſmall, that the attraction of the liquors to their ſides would prevent that celerity in the motion of the liquors, which is requiſite o ſenſations and motions. 4thly. If the nerves were pipes, they would be cylindrical ones, and conſequently not ſubject to diſeaſes; or at leaſt we could have no comprehenſion of the diſeaſes in them.

38. To the firſt of theſe objections, it is anſwered, that there are other glands where there is a manifeſt ſecretion, and in which the diſpoſition of the excretories is in much the ſame way as the encephalon: the kidnies, for example, have a reticulated cortex of veſſels, from which the Euſtachian or Bellinian medulla, conſiſting of longitudinal fibres, and a few blood-veſſels in the ſame direction, proceeds; and this medulla is collected into ten, twelve, or more papillæ, each of which is formed of numerous ſmall ſeparate pipes, which ſingly diſcharge the urine into the large membranous tubes; and theſe united, form the pelvis. Upon comparing this texture of the kidnies with that of the encephalon, the analogy will be found very ſtrong.

39. In anſwer to the ſecond objection, it is admitted, that microſcopes, injections, and all the other arts hitherto employed, have not ſhewn the cavities of the nervous fibrils, or the liquors contained in them; and from what was ſaid of the ſmallneſs of the nervous fibrils, it is not to be expected that ever they ſhould be ſeen. But ſo long as ſuch a number of little animals can every hour be brought to the objectors, in which they can as little demonſtrate the veſſels or contained fluids, it will not be granted to be concluſive reaſoning, that becauſe ocular demonſtration cannot be given of either the tubes or their contents, therefore they do not exiſt. For if we have any notion of an animal, it is its being an hydraulic machine, which has liquors moving in it as long as it has life; if therefore ſuch little animals have veſſels and liquors which we cannot ſee, why may not ſome of the veſſels and liquors of the human body be alſo inviſible to us?

To avoid this anſwer to the objection, it is further urged, that though we might not ſee the nervous tubes, or the liquors they contain, as they naturally flow; yet if ſuch liquors really exiſt, they ought to diſcover themſelves, either by a nerve's ſwelling when it is firmly tied; or that, however ſubtile their fluids are, they might be collected in ſome drops, at leaſt, when the cut end of a nerve of a living animal is kept ſome time in the exhauſted receiver of an air-pump. It is affirmed, that neither did the tied nerve ſwell between the brain and ligature, nor was there any liquor collected in the receiver of the air-pump; from whence it is concluded, that there is no liquor in the nerves.

It is advanced by ſome, who ſay they have tried theſe experiments, that in young animals the nerve does ſwell above the ligature, and that a liquor does drill out upon cutting a nerve. Whether ſwelling or liquor is ſeen or not, in theſe experiments, no concluſion for or againſt a nervous fluid can be made from them; for the ſwelling of the nerve after it is tied, or the efflux of liquors from its extremity, will never prove either to be the effect of the fluid in the proper nervous fibrils, ſo long as they might be occaſioned by the liquors in the larger veſſels of the cellular ſubſtance of the nerves; and if theſe ſame veſſels of the coats of the nerves do not diſcover their liquors by theſe experiments, it is much leſs to be expected, that the much more ſubtile nerves will diſcover theirs.

40. The third objection to the doctrine of the brain being a gland, and the nerves its excretories, ſuppoſes a more rapid motion neceſſary in the fluid of the nerves, than what moſt of the advocates for the nervous fluid will now admit; and is afterwards to be particularly conſidered in a more proper place.

41. The fourth objection being, that if nerves are excretories of a gland, they muſt be cylindrical pipes, in which no obſtructions or diſeaſes would happen; but ſince we daily ſee diſeaſes in the nerves, they muſt therefore not be ſuch excretories. The anſwer is, that diſeaſes frequently happen in the excretories of other glands, as of the liver, kidnies, &c. notwithſtanding their cylindrical form, and their much ſhorter and leſs expoſed courſe. When we conſider the very tender ſubſtance of the brain, the vaſt complication of veſſels there, the amazing ſmallneſs of the pipes going out from it, the many moving powers which the nerves are to undergo the ſhock of, and the many chances which the veſſels, membranes, and cellular ſubſtance accompanying the nerves have of being diſordered, and then affecting the nervous fibrils, we have very great reaſon to be ſurpriſed, that theſe cylindrical pipes are not much more frequently put out of order, by too great or too ſmall a quantity of liquors; by too viſcid or too thin fluids; by liquors conſiſting of too mild and ſluggiſh particles, or of too acrid pungent ones; by too great or too little motion given to the liquors; by the diameters of the pipes being too much ſtraitened, or too much inlarged, and by varieties of circumſtances which might be thought capable of diſturbing the functions of the nerves, ſuppoſing them to be cylindrical excretories of the gland, and the brain.

42. The numerous veſſels of the encephalon have induced ſome of thoſe who aſſert the nerves to be ſolid, to acknowledge, that there is a liquor ſecreted in the brain: but then they will not admit that this liquor is ſent out by the proper nervous fibrils; but that it is poured into the cellular ſubſtance in which the nerves lie, to keep them moiſt and ſupple, and therefore fit for exerting their elaſticity, vibration, &c. by which, in their opinion, the effects commonly aſcribed to nerves are produced.

43. Beſides theſe objections againſt the nerves acting as elaſtic ſtrings, this opinion has ſome other difficulties which may be objected to it: for inſtance, there is not one analogous example in the whole body of liquors ſecreted in a large gland, to be poured into a cellular ſubſtance, as is here ſuppoſed; the liquors in the cells of the tela cellularis of other parts, are ſeparated from the little arteries which are diſtributed to theſe cells.

Beſides, it cannot be imagined how a liquor ſecreted in the cortex of the brain ſhould make its way through the medulla, to come out into the cellular membranes on the ſurface of that medulla.

Finally, a very ſimple experiment, of injecting water by the artery of any member, and thereby filling the cellular ſubſtance of the nerves of that member, ſhews evidently, that the liquor of the cellular ſubſtance of the nerves has the ſame fountain as the liquor has in the tela cellularis any where elſe, that is, from the little arteries diſperſed upon it.

44. The doctrine of a fluid in the nerves, is not only thus ſupported by the analogy of the brain and nerves to the other glands and their excretories; but thoſe who maintain this doctrine, mention an experiment which they think abſolutely proves a fluid in the nerves. It is this: after opening the thorax of a living dog, catch hold of and preſs one or both the phrenic nerves with the fingers, the diaphragm immediately ceaſes to contract; ceaſe to compreſs the nerves, and the muſcle acts again: a ſecond time, lay hold of the nerve or nerves ſome way above the diaphragm, its motion ſtops. Keep firm the hold of the nerve, and, with the fingers of the other hand, ſtrip it down from the fingers which make the compreſſion towards the diaphragm, and it again contracts: a repetition of this part of the experiment three or four times, is always attended with the ſame effects; but it then contracts no more, ſtrip as you will, unleſs you remove the preſſure, to take hold of the nerves above the place firſt pinched; when the muſcle may again be made to contract, by ſtripping the nerve down towards it. This experiment I have made. Let any one try if he can imagine any other reaſonable account of theſe appearances, than that the preſſure by the fingers ſtopped the courſe of a fluid in the nerve; that ſo much of this fluid as remained in the nerve, betwixt the fingers and diaphragm, was forced into that muſcle by ſtripping; and when it was all preſſed away, the fingers above preventing a ſupply, the muſcle contracted no more till the fingers were removed, and a freſh flow by that means was received from the ſpinal marrow, or that part of the nerve which had not yet been ſo ſtripped.

To the concluſions from this experiment, it has been objected, 1. That the diaphragm is ſet in motion by ſtripping the nerve from, as well as towards, this muſcle; and this may be well expected; for a liquor in ſuch ſmall pipes hindered from flowing backwards by ligature, pinching fingers, or even the flow of their liquors from the fountain, will regurgitate forwards with velocity, when preſſed backwards. We ſee it happen in the ſtalks of tender ſucculent plants.

2. It is obſerved, that muſcles ceaſe to act when their veins are tied, as well as when their arteries or nerves are tied or cut, but that muſcles continue to act when their veins are cut; by which it would appear, that the overloading of the veſſels is an impediment to the action of muſcles, and therefore the ceaſing of their action when their arteries or nerves are tied or cut, may alſo be owing to the liquor in the branches of theſe pipes of muſcles ſtagnating, when it is not propelled by the flow of more liquor from their trunks, and not to any influence or moving power, which now ceaſes to be conveyed to them.

In making the experiments juſt now mentioned, it is to be obſerved, that the contraction of the muſcles ceaſes ſooneſt when the nerves, and lateſt when the veins are tied. That when veins are tied, not only the veſſels are overloaded, but all the cellular ſubſtance of the muſcles is filled with coagulated blood; whereas when the arteries and nerves are tied, the reverſe is ſeen, the muſcles are lax and of leſs bulk; ſo that in theſe caſes the ceaſing of the contraction of the muſcles ſeems to depend on very different cauſes, viz. a deprivation of neceſſary liquors in the one, and a redundancy of ſuperfluous blood in the other. Thus an elaſtic ſtick may be deprived of its elaſticity, by being made either too dry or too wet.

45. Some, convinced of the reaſonableneſs of the ſecretion of a liquor in the brain to be ſent out by the nerves, but not comprehending how a fluid could have ſuch a rapid retrograde motion, as they imagined was neceſſary for conveying the impreſſions of objects made on the extremities of nerves to the ſenſorium, ſuppoſed two ſorts of nerves; one, that conveyed a liquor for muſcular motion and nutrition; the other, compoſed of ſolid nerves, ſerving for organs of the ſenſes, to convey the vibrations communicated from objects to the ſenſorium.

46. To this opinion, the objections againſt the ſenſatory nerves acting by vibration may be made; and there is ſo little reaſon to ſuſpect any difference in the texture of the different parts of the brain or nerves, that, on the contrary, the ſtructure is every where ſimilar, and branches of the ſame nerve frequently ſerve both for ſenſation and motion.

It will ſoon be examined, how little neceſſity there is for ſuppoſing extremely rapid motions of the nervous fluid.

47. The hypotheſis of great celerity in the motion of the fluid of the nerves being neceſſary, gave alſo riſe to another diviſion of the nerves, into arterious or effluent, and venous or refluent. It was ſaid, that muſcular motion and nutrition depended on the arterious nerves; and that the ſenſations depended on an accelerated motion of the nervous fluid towards the brain, by the impreſſions which the objects of the ſenſes make upon the venous nerves. By this ſuppoſition, the abſurdity of rapid fluxes and refluxes in the ſame canal was prevented, and an advantage was thought to be gained by it, of ſaving too great a waſte of the fluid of the nerves, which otherwiſe the encephalon and ſpinal marrow could not ſufficiently ſupply to anſwer all the exigencies of life.

48. To this opinion it has been objected, 1ſt. That there is no example in the body of a ſecreted liquor being returned immediately, and unmixed, to the gland by which it was originally ſeparated from the maſs of blood; which would be the caſe were there venous nerves. 2dly. There is no occaſion for ſaving the fluid of the nerves in the manner propoſed; the organs for ſecreting that fluid being large enough to ſupply all that is neceſſary of it in the common functions of life. 3dly, If the fluid of the nerves was to be thus kept in a perpetual circulation, it would ſoon become too acrid for continuing with ſafety in ſuch ſenſible tender veſſels as the brain and nerves are compoſed of. 4thly, This hypotheſis will not anſwer the deſign for which it was propoſed: for though the momentary application of an object might cauſe an acceleration in the fluid of venous nerves, yet if the object was kept ap-

plied to the nerves, it would ſtop their fluid, ſo that it could not go forward to the brain; and therefore, according to this doctrine, we ſhould be ſenſible of no objects except thoſe whoſe application to the organs of the ſenſes was momentary.

49. Suppoſe it probable, that the encephalon and ſpinal marrow ſecern a liquor from the blood which is ſent into all the nerves, and that by the means of this liquor the nerves perform the offices commonly aſſigned to them; it is then neceſſary to inquire what kind of liquor this is, and how it moves, in order to determine how well its nature and motion are fitted for performing what is expected from it.

50. Some have ſuppoſed the liquor of the nerves to be of a very ſtrong acid or alcaline nature: but ſince none of our juices appear to be of this ſort, and ſince ſuch liquors irritate and deſtroy the parts of the body which they are applied to, we cannot conceive how the brain can ſeparate, or the nerves could bear any thing of ſuch an acrid nature. This tenderneſs and ſenſibility of theſe organs muſt hinder us abſolutely from ſuppoſing that the liquor of the nerves can be acrid or pungent, or of the nature of ſpirit of wine, hartſhorn, &c.

51. It has been imagined by ſome that the liquor of the nerves is capable of vaſt exploſion like gun-powder, or of violent ſudden rarefaction like air, or of ſtrong ebullition like boiling water, or the mixture of acids with alcaline liquors. But as the maſs of blood from which this fluid is derived, is not poſſeſſed of any ſuch properties, we cannot ſuppoſe the blood to furniſh what it has not in itſelf. Beſides, all theſe operations are two violent for the brain or nerves to bear; and when once they are begun, they are not ſo quickly controlled or reſtrained, as experience teaches us the nerves can be made to ceaſe from acting.

52. We are too little acquainted with the properties of an æther or electrical effluvia pervading every thing, to apply them juſtly in the animal œconomy; and it is as difficult to conceive how they ſhould be retained or conducted in a long nervous cord. Theſe are difficulties not eaſily ſurmounted.

53. In order to judge what kind of liquor this of the nerves muſt be, the beſt method is to examine the liquors of ſimilar parts of the body. All the glands ſeparate liquors from the blood much thinner than the compound maſs itſelf; ſuch is the liquor poured into the cavity of the abdomen, thorax, ventricles of the brain, the ſaliva, pancreatic juice, lymph, &c. Where ever there is occaſion for ſecreted liquors being thick and viſcid, in order to anſwer better the uſes they are intended for, nature has provided reſervoirs for them to ſtagnate in, where their thinner parts may be carried off by the numerous abſorbent veins diſperſed on the ſides of thoſe cavities; or they may exhale where they are expoſed to the open air. The mucus of the noſe becomes viſcid by ſtagnation; for, when it is immediately ſecreted, it is thin and watery; as appears from the application of ſternutatories, &c. The cerumen of the ears is of a watery conſiſtence, when juſt ſqueezing out. The mucus of the alimentary ca-

nal grows thick in the lacunæ. The bile in the hepatic duct has little more conſiſtence than lymph; that in the gall-bladder is viſcid and ſtrong. The urine is much more watery as it flows from the kidneys, than when it is excreted from the bladder. The ſeed is thin as it comes from the teſticles, and is concocted in the veſiculæ ſeminales, &c.

54. Hence, we may conclude, that a thin liquor is ſecreted in the cortex encephali and ſpinal marrow; and ſeeing the thinneſs of ſecreted liquors is generally as the diviſions of the veſſels into ſmall ſubtile branches, and that the ramifications within the ſcull are almoſt infinitely ſubtile, the liquor ſecreted in the encephalon may be determined to be among the fineſt or thinneſt fluids.

55. Seeing alſo that we can find no large reſervoir, where the liquor ſecerned in the cortical ſubſtance is depoſited, to have its finer parts taken of, we may reaſonably ſuppoſe, that it goes forward into the nerves in the ſame condition in which it is ſecerned

56. By fine or ſubtile animal liquors, is meant no more than thoſe which are very fluid, and which ſeem to conſiſt of a large proportion of watery particles, and a leſſer one of the oily ſaline, and terreſtrious particles. Some of the liquors which we can have in ſufficient quantity to make experiments with, are ſo fluid, and have ſo little viſcidity or coheſion of parts, that when laid upon a piece of clean mirror, they evaporate without leaving a ſtain; ſuch is the liquor ouſing out from the ſurface of the pleura, the lymph, and ſeveral others. If then theſe liquors which are ſubject to our examination, the ſecerning veſſels of which are ſo large that we can ſee them, have ſuch a ſmall coheſion of parts, it might not be unreaſonable to ſay, that the liquor of the nerves is as much more fine and fluid than lymph as the veſſels ſeparating it are ſmaller; and therefore that the fluid of the nerves is a defecated water, with a very ſmall proportion of the other principles extremely ſubtilized.

57. Two experiments are ſaid to contradict this opinion of the liquor of the nerves being ſo fluid and ſubtile. One is, that upon cutting the cauda equina of a living animal, a liquor as viſcid as the white of an egg drops out: the other is, that a wounded nerve yields a glairy ſanies. But theſe do not appear to be the proper fluid of the nerves; it being evident, that what is diſcharged in both theſe caſes, comes out of the cellular ſubſtance involving the nervous fibrils.

58. When we conſider how many experiments make it evident, that there is a conſtant uninterrupted ſtream of liquors flowing through all the canals of animals, which convey liquors compoſed of particles ſmaller than the diameter of their canal, which is always the caſe of the nerves in a natural ſtate; it is ſurpriſing how it ever could be imagined that the liquid of the nerves ſhould be obliged to flow from the brain to each muſcle the moment we will; or that this liquor ſhould flow back with the like ſwiftneſs from the extremity of each nerve, to which an object of ſenſation is applied. The nerves, as well as the other excretories of the glands, always are full of liquor; the degree of diſtenſion of the canals not being at all times

alike even in a ſound ſtate. But this happens without inconvenience, as the ſides of the canals have a power to accommodate themſelves to the preſent quantity, unleſs it is very much above or below the natural ſtandard; in both which caſes diſeaſes enſue.

59. The motion therefore of the fluid in the nerves is not only conſtant, but it is alſo equal, or nearly ſo: for, though the blood in the larger arteries is moved unequally by the unequal forces, the contraction of the ventricle of the heart, and the weaker power, the ſyſtole of the arteries; yet the difference between theſe two moving powers comes to be leſs and leſs perceptible, as the arteries divide into ſmaller branches; becauſe of the numerous reſiſtences which the liquors meet with, and becauſe the canals they move in become larger, till in the very ſmall arterious branches, there is no ſenſible difference in the velocity of the liquors from the effect of the heart or arteries. The motion of the fluids muſt ſtill be more equal in the excretories of glands, and particularly in thoſe where the veſſels have divided into very minute branches, and the liquors have no other propelling force but the heart and arteries; therefore the nervous fluid moves conſtantly, equally, and ſlowly, except when its courſe is altered by the influence of the mind, or by the preſſure of ſome neighbouring active organ.

60. There being neither proof nor probability of the valves ſuppoſed by ſome in nerves, we are not to aſſume them in accounting for any phænomena.

61. We have not, and it is probable cannot have any idea of the manner in which mind and body act upon each other; but if we allow, what no one attempts to deny, that the one is affected by the other, and that the fluid of the nerves (whatever name may be given it) is a principal inſtrument which the mind makes uſe of to influence the actions of the body, or to inform itſelf of the impreſſions made on the body, we muſt allow that the mind can direct this inſtrument differently, particularly as to quantity and celerity, though we muſt remain ignorant of the manner how many phænomena depending on this connection of mind and body are produced. Thus we ſhould in vain attempt to account for animals continuing after their heads were ſtruck off, or their hearts were cut out, to perform actions begun before they ſuffered any injury.

62. Let us now ſuppoſe the nervous fluid ſuch as has been argued for, to wit, a very fluid ſaponaceous water, moving in a conſtant equal, ſlow ſtream, from the encephalon and ſpinal marrow, in each of the proper nervous fibres, except when the motion is changed by ſome acceſſory cauſe, ſuch as the mind, preſſure of other parts, &c. and let us examine how well ſuch a ſuppoſition will agree with the phænomena of the three great functions, nutrition, ſenſation, and muſcular motion, which the nerves are principal inſtruments of.

63. We may ſay in general, that nerves can carry fluids to the moſt minute part of the body, to ſupply what is waſted in any of the ſolids; that the impreſſion made by the objects of the ſenſes on the very ſoft pulpy extremities of the nerves of the organs of the ſenſes,

muſt make ſuch a ſtop in the equal-flowing nervous fluid, as muſt inſtantaneouſly be perceptible at the fountain-head from which the pipes affected ariſe; that the conſtant flow of the liquor of the nerves into the cavities of the muſcular fibrillæ, occaſions the natural contraction of the muſcles, by the as conſtant niſus it makes to increaſe the tranſverſe, and to ſhorten the longitudinal diameter of each fibre; and that it is only to allow the mind a power of determining a greater quantity of this ſame fluid with a greater velocity into what muſcular fibres it pleaſes, to account for the voluntary ſtrong action of the muſcles.

64. But as ſuch a ſuperficial account would not be ſatisfactory, it will be expected that the principal phænomena of theſe three functions ſhould be explained by the means of ſuch a fluid as has been ſuppoſed; and that the ſeveral objections againſt this doctrine ſhould be anſwered; let us attempt this; and where we cannot extricate ourſelves from difficulties which may be thrown in, let us confeſs ignorance.

65. If water, with a very ſmall proportion of oils and ſalts from the earth, proves a fit nouriſhment for vegetables, ſuch a liquor, as the fluid of the nerves has been deſcribed, may not be unfit for repairing the waſte in animals.

The ſlow continual motion of this nervous fluid, to the moſt minute parts of the body, ſeems well enough calculated to ſupply the particles that are conſtantly worn off from the ſolids by the circulation of the liquors and neceſſary actions of life.

The greater proportional ſize of the encephalon in young creatures than in adults, ſeems calculated for their greater proportional growth; for the younger the animal is, the larger encephalon and ſpeedier growth it has.

A palſy and atrophy of the members generally accompanying each other, ſhew, that nouriſhment, ſenſation, and motion, depend on the ſame cauſe.

It was ſaid, that the nerves were principal inſtruments in nutrition; not that they were the ſole inſtruments; and therefore an atrophy may proceed from the compreſſion, or other leſion of an artery, without being an objection to the doctrine here advanced.

66. All objects of ſenſe, when applied to their proper organs, act by impulſe; and this action is capable of being increaſed, by increaſing the impelling force. In tangible objects, that is clearly evident; the cloſer they are preſſed to a certain degree, the more diſtinct perception enſues. Odorous particles require the aſſiſtance of air moved rapidly, to affect our noſe: ſapid ſubſtances, that are ſcarce ſufficient to give us an idea of their taſte by their own weight, are aſſiſted by the preſſure of the tongue upon the palate: the rays of light collected, drive light bodies before them: ſound communicates a vibration to all bodies in harmonic proportion with it.

The impulſes thus made by any of theſe objects on the ſoft pulpy nerves, which are full of liquor, preſſes their ſides or extremities, and their liquor is hindered to flow ſo freely as it did. The canals being all full, this reſiſtance muſt inſtantaneouſly affect the whole column of fluids in the canals that are preſſed, and their origins, and have the ſame effect as if the impulſe had been made upon the origin itſelf. To illuſtrate this by a groſs compariſon, let a perſon puſh water out of a ſyringe, through a long flexible pipe fixed to the ſyringe, and he is ſenſible of reſiſtance, or a puſh backwards, the moment any one ſtops the orifice of the pipe, or cloſes the ſides of it with his fingers. This impulſe made on the nerves, and thus communicated to their origin, varies according to the ſtrength or weakneſs, the quickneſs or ſlowneſs, the continuance or ſpeedy removal, the uniformity or irregularity, the conſtancy or alternation, &c. with which objects are applied to the nerves.

When any object is regularly applied with due force to a nerve, rightly diſpoſed to be impreſſed by it, and is communicated, as already explained, to the ſenſorium, it gives a true and juſt idea of the object to the mind.

The various kinds of impulſes which the different claſſes of objects make, occaſion in animals, which ought to have accurate perceptions of each object, a neceſſity of having the different organs of the ſenſes variouſly modified, ſo that the ſeveral impulſes may be regularly applied to the nerves in each organ; or, in other words, we muſt have different organs of the ſenſes fitted to the different claſſes of objects.

The objects having one common property of impulſe, ſo all the organs have moſt of the properties of the organ of touching in common with the papillæ of the ſkin. In the noſe and tongue, this is evident: in ſome operations of the eyes we can alſo perceive this; as we may likewiſe do in ſome caſes where matter is collected in the internal ear.

Theſe properties common to the different objects and organs occaſion frequently uncommon effects in the application of an object to an organ proper to another object of ſenſation; for ſometimes we have the ſame idea as if the object had been applied to its own proper organ: at other times the object is as it were changed, and we have the idea as if the organ had had its own proper object applied to it. Thus, for example, light is the proper object to be applied to the eye, to give us any idea of colours; yet when all light is excluded from the eyes, an idea of light and colours may be excited in us by couching, ſneezing, rubbing, or ſtriking the eye-ball.——A cane vibrating, ſo as not to excite ſound perceptible to the ear, applied to the teeth, raiſes a ſtrong idea of ſound; as a little inſect creeping in the *meatus auditorius* alſo does. The fingers applied to two rough ſurfaces, rubbing on each other, are ſenſible of the ſound they make; ſurgeons who have any practice in the cure of fractured bones can bear witneſs to the truth of this. The fingers dipped in acid and ſeveral other acrid liquors, have a ſenſation very like to taſting. Smelling and taſting we all know are ſubſervient and aſſiſting to each other. From ſuch examples we have further proof of one general cauſe of our ſenſations, to wit, impulſe from the objects; and of ſuch a ſimilarity and relation in the organs, as might give reaſon for imagining that any one of them would be capable of producing the effect of another, if the impulſes of the different objects could be regularly applied to each. Hence light and ſound may affect inſects and other animals that are without eyes or ears.

If the impulſe of an object is applied with due force, but irregularly, a confuſed idea of the object is raiſed. Diſtant objects are confuſed to *myopes*, as very near ones are to *preſbytæ*.

If the application of the impulſe is regular, but the force with which it is applied is too weak, our perception of the object is too faint. One may whiſper ſo low as not to be heard.

If the application of objects is too violent, and there is any danger of the tender organs of our ſenſes being hurt or deſtroyed, an uneaſy ſenſation we call *pain* is raiſed, whatever the organ thus injured is. The object of feeling affects every organ: thus preſſure, ſtretching, cutting, pricking, acrid ſalts, pungent oils, great heat, violent cold, &c. occaſion pain, where-ever they are applied. Beſides, every particular organ can be affected with pain by the too violent application of its own proper object. Too much light is painful to the eyes; very loud ſound ſtuns the ears; very odorous bodies and too ſapid objects hurt the noſe and tongue. A pretty ſure proof this, that the objects of our ſenſes all act, and that the organs are all impreſſed, in nearly the ſame way.

Since a middle impulſe, neither too ſmall nor too great, is neceſſary for a clear perception of objects, we ſhould often be in danger of not diſtinguiſhing them, if we were not ſubjected to another law, to wit, that numerous impulſes made at once, or in a quick ſucceſſion to each other, increaſe our perceptions of objects. Thus, ſuch ſound as would not be heard on a mountain top, will be diſtinctly heard in a wainſcotted chamber. We feel much more clearly a tangible object when our finger is drawn along it than when applied with the ſame force, but by a ſingle preſſure, upon it. We make repeated applications of odorous and ſapid objects, when we wiſh to ſmell or taſte accurately. The end of a burning ſtick appears much more luminous when quickly whirled in a circle than when at reſt.

Whenever the uneaſy ſenſation, pain, is raiſed by the too ſtrong application of objects, a ſort of neceſſity is as it were impoſed upon the mind to endeavour to get free of the injuring cauſe, by either withdrawing the grieved part of the body from it, as one retires his hand when his finger is pricked or burnt; or the injuring cauſe is endeavoured to be forced from the body, as a teneſmus excites the contraction which puſhes acrid fœces out of the rectum. In both theſe operations, a convulſive contraction is immediately made in the leſed part, or in the neighbourhood of it; and if the irritation is very ſtrong or permanent, the greater part of the nervous ſyſtem becomes affected in that ſpaſmodic or convulſive way. Is it this neceſſity which obliges the mind to exert herſelf in reſpiration, or in the action of the heart, when the lungs or heart are gorged with blood? or the iris to contract the pupil, when the eye is expoſed to ſtrong light? or ſneezing to be performed when the noſe is tickled? &c. Will not a ſtimulus of any nerve more readily affect thoſe with which it is any where connected than the other nerves of the body? May not this ſympathy ſerve as a monitor of the mind rather to employ the organs furniſhed with nerves thus connected, to aſſiſt in freeing her of any uneaſy ſenſation, than to make uſe of any other organs? Will not this in ſome meaſure account for many ſalutary operations performed in the body before experience has taught us the functions of the organs performing them?

This niſus of the mind to free the body of what is in danger of being hurtful, may ſerve to explain the phænomena of many diſeaſes, when we are acquainted with the diſtribution of the particular nerves; and from this we can underſtand the operation of medicines that ſtimulate; and may learn how, by exciting a ſharp, but momentary pain, we may free the body of another pain that would be more durable; and that, by having it thus in our power to determine a flow of the liquor of the nerves to any particular part, for the benefit of that part, or the relief of any other diſeaſed part, we can do eſſential ſervice by a right application of the proper medicines.

If a pain-giving cauſe is very violent or long continued, it deſtroys the organs either irrecoverably, or does them ſo much injury that they only gradually recover: people have become blind or deaf for all their lives after a violent effect of light on their eyes, or of ſound on their ears; and we are frequently expoſed to as much light and ſound as to make us unfit to ſee or hear for a conſiderable time. I would explain this by a ligature put round the tender branch of an herb. This ligature drawn to a certain degree, may weaken the canals ſo as to be unfit for the circulation of the juices a conſiderable time, till they are gradually explicated and made firm by theſe juices: a ſtricter ligature would diſorder the ſtructure of the fibres ſo much, that the liquors could not recover them. The analogy is ſo plain, that it requires no commentary. Thus the influence of a nerve tied with an artery in the operation of an aneuriſm may ceaſe for ſome time, but be afterwards recovered.

67. 1. In applying the fluid of the nerves to the action of muſcles, it was ſaid, that the natural or involuntary contraction of muſcles was the niſus which the nervous fluid flowing conſtanty into the muſcular fibres makes to diſtend theſe fibrils, by enlarging their tranſverſe diameters and ſhortening their axes; and that voluntary contraction was owing to a greater quantity of that nervous liquor determined towards the muſcle to be put in action, and poured with greater momentum into the muſcular fibrils, by the power of the mind willing to make ſuch a muſcle to act, or obliged to do it by an irritating pain-giving cauſe.

2. There are ſome who object to this account of muſcular motion, that if there is no outlet for the liquor ſuppoſed to be poured into muſcular fibres, muſcles would always be in a ſtate of contraction, which they are not; and if there is a paſſage from the fibrils, the liquor would flow out as faſt as it was thrown in; and therefore no diſtenſion of the fibres or contraction of the muſcles could be made.

3. It is obſerved, in anſwer to this objection, that notwithſtanding the evident outlet from the arteries into the veins, yet the arteries are

diſtended by the ſyſtole of the heart, or any other cauſe increaſing the momentum of the blood.

4. It has alſo been objected to, that, if it was true, the volume of the muſcle in contraction neceſſarily would be conſiderably increaſed by ſo much liquor poured into its fibrils; whereas it does not appear, by any experiment, that the volume of a muſcle is increaſed by its being put into action.

5 To this it has been anſwered, 1. That when the axes of muſcular fibres are ſhortened, and their tranſverſe diameters are enlarged, the capacities of their fibres, and conſequently their volume may not be changed, the diminution one way balancing the increaſe in the other. 2. That the ſpaces between the muſcular fibres are ſufficient to lodge theſe fibres when they ſwell during the contraction of a muſcle, without any addition to its bulk; and that it is evident that theſe ſpaces between the fibrils are thus occupied by the compreſſion which the larger veſſels of muſcles, which run in thoſe ſpaces, ſuffer during the action of the muſcle; it is ſo great as to drive the blood in the veins with a remarkable accelerated velocity.

6. Another objection to the action of muſcles being owing to the influx of a fluid into their fibrils is, that muſcular fibres are diſtractile, or capable of being ſtretched; and therefore, when a fluid is poured into their hollow fibrils, they would be ſtretched longitudinally, as well as have their tranſverſe diameters increaſed; that is, a muſcle would become longer, as well as thicker, when it is put into action; whereas it is certainly known that a muſcle is ſhortened while it acts.

7. In anſwer to this, it has been obſerved, that though muſcular fibrils are diſtractile, yet they will not yield to, or be ſtretched by every force, however ſmall, that might be applied to them. A cord that can be ſtretched in length by the weight of a pound or two, would not yield in the leaſt to an ounce or two; and it muſt likewiſe be obſerved, that gradually as any body is ſtretched, its reſiſtance to the ſtretching force increaſes. A rope may be ſtretched to a certain length by a pound weight appended to it, which would require two pounds to ſtretch it very little further; and therefore the general obſervation of animal fibres being diſtractile, cannot be a reaſonable objection to the account of muſcular motion above mentioned, unleſs a proof is brought that the force which the liquid of the nerves muſt exert upon each fibre of a muſcle, in order to make it act, is capable of diſtracting or ſtretching the fibres; which has not yet been attempted to be proved.——It would appear from the pain cauſed by too great an effort of muſcles, eſpecially in weak people, that muſcular fibres can bear very little diſtraction without danger of a ſolution of continuity.

8. Muſcles ceaſing to act when their arteries are tied or cut, and being brought into motion by injecting liquors into the arteries even of a dead animal, has been mentioned as objections to the nervous influence cauſing their contractions.

To the firſt it may be anſwered, that the tying or cutting of the nerves produces the effect of making the contraction ceaſe than ſtopping the influx of the arterious blood does; and it will be univerſally allowed, that the influx of blood into muſcles is neceſſary for performing their functions right. Whoever obſerves the motion which injecting water or any other liquor into the arteries of a dead animal, cauſes in its muſcles, will not compare it to what contraction, whether voluntary or excited by irritation, he may ſee in a living one.

9. If muſcular motion depends on the influx of the nervous liquid, the inſtantaneous contraction of a muſcle, when the mind wills to make it act, will be eaſily underſtood from the nerves being always full of their liquor.

10. If either the nerves of any muſcle do not furniſh a ſufficient quantity of their liquor, or if the fibres of a muſcle become too eaſily diſtractile, ſuch muſcle will be unactive or paralytic.

11. If too great a quantity of the liquor of the nerves is determined to a muſcle or muſcles, by any cauſe which the mind cannot command, ſuch muſcle or muſcles will be convulſed.

12. If the motion of the liquid of the nerves is not uniform, but by diſeaſe becomes irregular, an alternate relaxation and contraction of muſcles may be the conſequence. Hence trembling, palſies, chorea ſancti viti, &c. Hence alſo the convulſive tremors which animals have when they loſe much blood.

13. Though the nerves may not furniſh ſo much liquor as may be ſufficient to make muſcles contract with ſtrength enough to overcome the reſiſtances to their actions, yet there may be a ſufficient quantity of liquor in the nerves to allow the impreſſions of objects to be conveyed to the ſenſorium. This may be one cauſe of a member's being ſometimes ſenſible after it cannot be moved.

14. Except the liquor of the nerves acquires ſome energy in the brain, which we have no reaſon to think the circulation of the fluids in the veſſels can give it, or except it has other properties than what we can diſcover in it, or except there is an agent regulating its momentum and courſe to different parts which we are not conſcious of; if ſome of theſe, I ſay, do not obtain, the action of the heart continuing of equal force to propel our liquors, notwithſtanding all the reſiſtances that are to it, is not to be explained.

15. All muſcles, but eſpecially the heart, continue to contract in an irregular way, after they are cut away from the animal to whom they belonged; owing perhaps to the liquors continuing to flow in the ſmall veſſels, and being poured irregularly into the muſcular fibrillæ.

16. It is ſaid that a muſcle cut out of the body continues ſome time capable of contraction; whereas by tying its arteries or nerves, while it is otherwiſe entire in the body, it loſes its contracting power, which therefore does not depend on theſe organs, the arteries or nerves.

The loſs of the power of acting when the arteries or nerves are tied while the muſcle is in the body, is denied by ſome who made the trial; and it might be expected, that the motion of a muſcle would be more conſpicuous where there is no reſiſtance to it, as is the caſe when it is cut away from all the parts it is connected with, than when its connection remains with parts reſiſting its contractile efforts.

17. When the heart, or any other muſcle cut away from an animal, has ceaſed to contract, its contraction may again be reſtored, by breathing upon it, or pricking it with any ſharp inſtrument. That heat or pricking ſhould, by their ſtimulus, occaſion contraction in a living creature, may be underſtood; but how they ſhould have the ſame effect in a muſcle ſeparated from an animal, I know not.

18. Some have thought the ganglions of nerves to be glandular, and to perform a ſecretion. Others, from their firm texture, imagine them to be muſcular, and to ſerve to accelerate the motion of the liquor in the nerves which proceed from them; but as no proof is offered of either of theſe opinions, they cannot be maintained. Others would make them ſerve, 1. To divide a ſmall nerve into many nerves, and by theſe means to increaſe the number of nervous branches. 2. To make nerves come conveniently by different directions to the parts to which they belong. 3. To re-unite ſeveral ſmall nervous fibres into one large nerve. Since no proof is brought that theſe three things cannot be done without the interpoſition of a ganglion; but on the contrary, we ſee them performed where there are no ganglions, we muſt ſtill acknowledge ignorance concerning the uſes of theſe knotes, the ganglions.

Of the PARTICULAR NERVES.

It is generally ſaid, that there are forty pair of nerves in all; ten of which come out from the encephalon, and the other thirty have their origin from the ſpinal marrow.

Of thoſe which come from the encephalon, the firſt is the olfactory, which long had the name of the mammillary proceſſes of the brain, becauſe in the brutes, cows and ſheep, which were moſt commonly diſſected by the antients, the anterior ventricles of the brain are extended forwards upon theſe nerves, and adhere ſo firmly to them, that they ſeem to make the upper ſide of the nerves. Each of them being large, where it begins to be ſtretched out, and gradually becoming ſmaller as it approaches the cribriform bone, was imagined to reſemble a nipple. Thoſe who miſtook the ventricles for part of the nerves, obſerving the cavity of them full of liquor, concluded, that theſe olfactory nerves ſerved to convey the ſuperfluous moiſture of the brain to the holes of the ethmoid bone through which it paſſed into the noſe. But in man, the ventricles of whoſe brain are not thus extended forwards, theſe nerves are ſmall, long, and without any cavity, having their origin from the corpora ſtriata, near the part where the internal carotid arteries are about to ſend off their branches to the different parts of the brain; and in their courſe under the anterior lobes of the brain, which have each a depreſſion made for lodging them, the human olfactory nerves become larger, till they are extended to the cribriform bone; where they ſplit into a great number of ſmall filaments, to paſs through the little holes in that bone; and being joined by a branch of the fifth pair of nerves, are ſpread on the membrane of the noſe.

The tender ſtructure and ſudden expanſion of theſe nerves on ſuch a large ſurface, render it impoſſible to trace them far; which has made ſome authors deny them to be nerves: but when we break the circumference of the cribriform lamella, and then gently raiſe it, we may ſee the diſtribution of the nerves ſome way on the membrane of the noſe.

The contrivance of defending theſe long ſoft nerves from being too much preſſed by the anterior lobes of the brain under which they lie, is ſingular; becauſe they have not only the prominent orbitar proceſſes of the frontal bone to ſupport the brain on each ſide, with the veins going into the longitudinal ſinus, and other attachments bearing it up, but there is a groove formed in each lobe of the brain itſelf for them to lodge in. Their ſplitting into ſo many ſmall branches before they enter the bones of the ſkull, is alſo peculiar to them; for generally the nerves come from the brain in diſgregated filaments, and unite into cords, as they are going out at the holes of the bones. This contrivance is the beſt for anſwering the purpoſe they are deſigned for, of being the organ of ſmelling; for had they been expanded upon the membrane of the noſe into a medullary web, ſuch as the optic nerve forms, it would have been too ſenſible to bear the impreſſions of ſuch objects as are applied to the noſe; and a diſtribution in the more common way, of a cord ſending off branches, would not have been ſufficient for ſuch an organ of ſenſation.

The ſecond pair of nerves, the optic, riſing from the thalami nervorum opticorum, make a large curve outwards, and then run obliquely inwards and forwards, till they unite at the fore-part of the ſella turcica; then ſoon divide, and each runs obliquely forwards and outwards to go out at its proper hole in the ſphenoid bone, accompanied with the ocular artery, to be extended to the globe of the eye, within which, each is expanded into a very fine cup-like web, that lines all the inſide of the eye as far forwards as the ciliary circle, and is univerſally known by the name of retina.

Notwithſtanding the ſubſtance of this pair of nerves ſeems to be blended at the place where they are joined, yet obſervations of people, whoſe optic nerves were not joined, and of others who were blind of one eye from a fault in the optic nerve, or in thoſe who had one of their eyes taken out, make it appear, that there is no ſuch intimate union of ſubſtance; the optic nerve of the affected ſide only being waſted, while the other was large and plump. And the ſame obſervations are contradictory to the doctrine of a decuſſation of all the nerves; for the diſeaſe could be traced from the affected eye, to the origin of the nerve on the ſame ſide. In many fiſhes indeed, the doctrine of decuſſation is favoured; for their optic nerves plainly croſs each other, without any union at the part where they are joined in men and moſt quadrupeds.

Theſe people, whoſe optic nerves were not joined, having neither ſeen objects double, nor turned their eyes different ways, is alſo a plain proof, that the conjunction of the optic nerves will not ſerve to account for either the uniform motions of our eyes, or our ſeeing objects ſingle with two eyes, though it may be one cauſe of the remarkable ſympathy of the one eye with the other in many diſeaſes.

The retina of a recent eye, without any preparation, appears like a very fine web, with ſome blood-veſſels coming from its center to be diſtributed on it; but, after a good injection of the arteries that run in the ſubſtance of this nerve, as is common to other nerves, it is with difficulty that we can obſerve its nervous medullary ſubſtance. The ſituation of theſe veſſels in the central part of the optic nerve; the want of the medullary fibres here, and the firmneſs of this nerve before it is expanded at its entry into the ball of the eye, may be the reaſon why we do not ſee ſuch bodies, or parts of bodies, whoſe picture falls on this central part of the retina. An inflammation in thoſe arteries of the retina, which ſeveral fevers and an ophthalmia are generally attended with, may well account for the tenderneſs in the eyes, and inability to bear the light, which people have in theſe diſeaſes. The over-diſtenſion of theſe veſſels may likewiſe ſerve to account for the black ſpots obſerved on bright coloured bodies eſpecially, and for that ſmoaky fog through which all objects appear to be ſeen by people in ſome fevers. If theſe veſſels loſe their tone, and remain preternaturally diſtended, no objects affect our retina, though the eye externally appears ſound; or this may be one cauſe of an amauroſis or gutta ſerena. From a partial diſtenſion of theſe veſſels, or paralyſis of a part of the retina, the central part, or the circumference, or any other part of objects, may be loſt to one or both eyes.

The third pair of nerves riſe from the anterior part of the proceſſus annularis, and piercing the dura mater a little before, and to a ſide of the ends of the poſterior clinoid proceſs of the ſphenoid bone, run along the receptacula, or cavernous ſinuſes, at the ſide of the ephippium, to get out at the foramina lacera; after which each of them divides into branches, of which one, after forming a little ganglion, is diſtributed to the globe of the eye; the others are ſent to the muſculus rectus of the palpebra, and to the attollens, adductor, deprimens, and obliquus minor muſcles of the eye-ball. Theſe muſcles being principal inſtruments in the motions of the eye-lid and eye-ball, this nerve has therefore got the name of the motor oculi. I have frequently obſerved in convulſions the eye lids widely opened, the cornea turned upward and outwards, and the eye-balls ſunk in the orbit; which well deſcribed the conjunct action of the muſcles which this pair of nerves ſerves. The diſtenſion of a conſiderable branch of the carotid, which paſſes over this nerve near its origin on each ſide, may poſſibly be the reaſon of the heavineſs in the eye-lids and eyes, after drinking hard, or eating much.

The fourth pair of nerves, which are the ſmalleſt of any, derive their origin from the back-part of the baſe of the teſtes; and then making a long courſe on the ſide of the annular protuberance, enter the dura mater a little farther back, and more externally than the third part, to run alſo along the receptacula, to paſs out at the foramina lacera, and to be entirely ſpent on the muſculi trochleares, or ſuperior oblique muſcles of the eyes. Theſe muſcles being employed in performing the rotatory motions, and the advencement of the eye-balls forward, by which ſeveral of our paſſions are expreſſed, the nerves that ſerve them have got the name of pathetici. Why theſe ſmall nerves ſhould be brought ſo far to this muſcle, when it could have been ſupplied eaſily by the motor oculi, I know not.

The fifth pair are large nerves, riſing from the annular proceſſes where the medullary proceſſes of the cerebellum join in the formation of that tuber, to enter the dura mater near the point of the petrous proceſs of the temporal bones; and then ſinking cloſe by the receptacula at the ſides of the ſella turcica, each becomes in appearance thicker, and goes out of the ſcull in three great branches.

The firſt branch of the fifth is the Ophthalmic, which runs through the foramen lacerum to the orbit, having in its paſſage thither a connexion with the ſixth pair. It is afterwards diſtributed to the ball of the eye with the third; to the noſe, along with the olfactory, which the branch of the fifth that paſſes through the foramen orbitarium internum joins, as already mentioned in the deſcription of the firſt pair. This ophthalmic branch alſo ſupplies the parts at the internal canthus of the orbit, the glandula lacrymalis, fat, membranes, muſcles, and teguments of the eye-lids; its longeſt, fartheſt extended branch paſſing through the foramen ſuperciliare of the os frontis, to be diſtributed to the forehead.

The ſmall fibres which this firſt branch of the fifth and the third pair of nerves ſend to the eye-ball, being ſituated on the optic nerve, and, after piercing the ſclerotic coat, running along the choroid coat on the outſide of the retina in their courſe to the uvea or iris, may be a cauſe of the ſympathy between the optic nerve and the uvea; by which we more readily acquire the habit of contracting the iris, and thereby leſſen the pupil, when too ſtrong light is excluded, and on the contrary enlarge the pupul when the light is too faint. This, with the ſympathy which muſt ariſe from ſome of the nerves of the membrane of the noſtrils, being derived from this firſt branch of the fifth pair of nerves, may alſo be the cauſe, why an irritation of the retina, by too ſtrong light, may produce ſneezing, as if a ſtimulus had been applied to the menbrane of the noſe itſelf; why preſſing the internal canthus of the orbit, ſometimes ſtops ſneezing; why irritation of the noſe or of the eye cauſes the eye lids to ſhut convulſively, and makes the tears to flow plentifully; and why medicines put into the noſe, frequently do great ſervice in diſeaſes of the eyes. In the megrim all the branches of the nerve diſcover themſelves to be affected: for the forehead is racked with pain, the eye-ball is painful, and feels as if it was ſqueezed, the eye-lids ſhut convulſively, the tears trickle down, and an uneaſy heat is felt in the noſe. Hence we can underſtand where external medicines will have the beſt effect, when applied to remove this diſeaſe, to wit, to the membrane of the noſe, and to the forehead; why alternate preſſure near the ſuperciliary hole of the frontal bone, or ſneezing, ſometimes give immediate relief in the megrim; why the ſight may be loſt by an injury done to the ſupra orbitar branch; how it may be reſtored by agitation of that branch of this nerve.

The ſecond branch of the fifth pair of nerves may be called maxillaris ſuperior, from its ſerving principally the parts of the upper jaw. It goes out at the round hole of the ſphenoid bone, and ſends immediately

mediately one branch into the channel on the top of the antrum maxillare; the membrane of which and the upper teeth are ſupplied by it in its paſſage. As this branch is about to go out at the foramen orbitarium externum, it ſends a nerve through the ſubſtance of the os maxillare to come out at ſteno's duct, to be diſtributed to the fore-part of the palate; and what remains of it eſcaping at the external orbitar hole, divides into a great many branches, that ſupply the cheek, upper lip, and noſtril. The next conſiderable branch of the ſuperior maxillary nerve, after giving branches which are reflected through the ſixth hole of the ſphenoid bone, to join the intercoſtal where it is paſſing through the ſcull with the carotid artery, and the portio dura of the ſeventh pair, as it paſſes through the os petroſum, is ſent into the noſe by the hole common to the palate and ſphenoidal bone; and the remaining part of this nerve runs in the palato-maxillaris canal, giving off branches to the temples and pterygoid muſcles, and comes at laſt into the palate to be loſt. Hence, the ach in the teeth of the upper jaw occaſions a gnawing pain deep ſeated in the bones of the face, with ſwelling in the eye-lids, cheek, noſe, and upper lip; and on the other hand, an inflammation in theſe parts, or a megrim, is often attended with ſharp pain in the teeth. Hence, an obſtruction in the duct of the maxillary ſinus, which obliges the liquor ſecreted there to find out a preternatural route for itſelf, may be occaſioned by the pain of the teeth. Hence, the upper lip frequently ſuffers when the palate or noſe is ulcerated.

The third or maxillaris inferior branch of the fifth pair going out at the oval hole of the ſphenoid bone, ſerves the muſcles of the lower jaw, and the muſcles ſituated between the os hyoides and jaw: all the ſalivary glands, the amygdalæ, and the external ear, have branches from it: it has a large branch loſt in the tongue, and ſends another through the canal in the ſubſtance of the lower jaw to ſerve all the teeth there, and to come out at the hole in the fore-part of the jaw, to be loſt in the chin and under lip. Hence a convulſive contraction of the muſcles of the lower jaw, or the mouth's being involuntarily ſhut, a great flow of ſpittle or ſalivation, a pain in the ear, eſpecially in deglutition, and a ſwelling about the throat, are natural conſequences of a violent irritation of the nerves of the lower teeth in the tooth-ach; and pain in the teeth and ear, is as natural a conſequence of an angina. Hence alternate preſſure on the chin may ſometimes relieve the violence of a tooth-ach. Hence deſtroying the nerves of a tooth by actual or potential cauteries, or pulling a carious tooth, often removes theſe ſymptoms immediately. Hence no cure is to be found for ſome ulcers in the upper or lower jaw, but by drawing a tooth. Hence in cancers of the upper lip, the ſalivary glands are in danger of being affected, or the diſeaſe may be occaſioned to the lip by its beginning in the glands. Perhaps the ſympathy of the organs of taſting and ſmelling may in ſome meaſure depend on their both receiving nerves from the fifth pair.

The ſixth pair of nerves, which is the ſmalleſt except the fourth, riſes from the fore-part of the corpora pyramidalia; and each entering the dura mater ſome way behind the poſterior clinoid proceſs of the ſphenoid bone, has a long courſe below that membrane, and within the receptaculum at the ſide of the ſella turcica, where it is immerſed in the blood of the receptacle; but for what purpoſe I am ignorant. It goes afterwards out at the foramen lacerum into the orbit, to ſerve the abductor muſcle of the eye. A defect in this nerve may therefore be one cauſe of a ſtrabiſmus. In the paſſage of this nerve below the dura mater, it lies very contiguous to the internal carotid artery, and to the ophthalmic branch of the fifth pair of nerves. At the place where the ſixth pair is contiguous to the carotid, a nerve either goes from each of them in an uncommon way, to wit, with the angle beyond where it riſes obtuſe, to deſcend with the artery, and to form the beginning of the intercoſtal nerve, according to the common deſcription; or, according to other authors, this nerve comes up from the great ganglion of the intercoſtal, to be joined to the ſixth here.

The arguments for this latter opinion are, that, according to the common doctrine, this beginning of the intercoſtal nerve, as it is called, would riſe in a manner not ſo ordinary in nerves. In the next place, it is obſerved, that the ſixth pair is larger near to the orbit, than it is before it comes to the place where this nerve is ſaid to go off; and therefore it is more probable, that it receives an addition there, rather than gives off a branch. Laſtly, it is found, that upon cutting the intercoſtal nerves of living animals, the eyes plainly were affected; they loſt their bright water; the gum, or gore, as we call it, was ſeparated in greater quantity; the pupil was more contracted; the cartilaginous membrane, at the internal canthus, came more over the eye; and the eye-ball itſelf was diminiſhed.

In defence of the more common doctrine, this objection is anſwered thus. 1ſt, That other branches of nerves go off in a reflected way, as well as this does, ſuppoſing it to be the beginning of the intercoſtal; and that the reflexion would rather be greater, if it is thought to come up from the intercoſtal to the ſixth. 2dly, It is denied that this nerve is in general thicker at is fore than its back-part; and if it was ſuppoſed to be thickeſt nearer to the orbit, the concluſion made above could not be drawn from this appearance, becauſe other nerves enlarge ſometimes where there is no addition made to them, as in the inſtance already mentioned of the trunk of the fifth pair while below the dura mater. 3dly, The experiments on living animals ſhew indeed, that the eyes are affected upon cutting the intercoſtal nerve, but not in the way which might have been expected, if the intercoſtal had furniſhed ſuch a ſhare of the nerve that goes to the abductor muſcle of the eye; for it might have been thought, that this muſcle would have been ſo much weakened immediately upon cutting the intercoſtal, that its antagoniſt the adductor would have greatly prevailed over it, and have turned the eye ſtrongly in towards the noſe; which is not ſaid to be a conſequence of this experiment. So that the arguments are ſtill equivocal; and more obſervations and experiments muſt be made, before it can be determined with certainty, whether the ſixth pair of nerves gives or receives a branch here.

At this place where the intercoſtal begins, the fifth pair is contiguous and adherent to the ſixth; and it is generally ſaid, that the ophthalmic branch of the fifth gives a branch or two to the beginning of the intercoſtal, or receives ſuch from it. Others deny any ſuch communication between them; and thoſe who affirm the communication confeſs, that in ſome ſubjects they could not ſee it. After examining the nerves here in a great many ſubjects, I cannot determine whether there are nervous filaments going from the one to the other or not. Sometimes I have thought that I traced them evidently; at other times I obſerved that what I diſſected from nervous filaments, was collapſed cellular ſubſtance; and in all the ſubjects where I had puſhed an injection ſucceſsfully into the very ſmall arteries, I could only obſerve a plexus of veſſels connecting the one to the other. In any of theſe ways, however, there is as much connection as, we are aſſured from many experiments and obſervations on other nerves, is ſufficient to make a very great ſympathy among the nerves here. Poſſibly the appearances in the eyes of dogs, whoſe intercoſtal nerves were cut, might be owing to this ſympathy.

The ſeventh pair comes out from the lateral part of the annular proceſs, behind where the medullary proceſs of the cerebellum are joined to that tuber; and each being accompanied with a larger artery than moſt other nerves, enters the internal meatus auditorius, where the two large bundles of fibres, of which it appeared to conſiſt within the ſcull, ſoon ſeparate from each other; one of them entering by ſeveral ſmall holes into the veſtible, cochlea, and ſemicircular canals, is ſtretched on this inner camera of the ear in a very ſoft pulpy ſubſtance; and being never ſeen in the form of a firm cord, ſuch as the other parcel of this and moſt other nerves become, is called portio Mollis of the auditory nerve.

The other part of this ſeventh pair paſſes through Galen's foramen cæcum, or Follopius's aquæduct, in its crooked paſſage by the ſide of the tympanum; in which paſſage, a nerve ſent from the lingual branch of the inferior maxillary nerve, along the outſide of the tuba Euſtachiana, and croſs the cavity of the tympanum, where it has the name of chorda tympani, is generally ſaid to be joined to it. The very acute angle which this nerve makes with the fifth, or the ſudden violent reflection it would ſuffer on the ſuppoſition of its coming from the fifth to the ſeventh, appears unuſual; whereas, if we ſuppoſe it comes from the ſeventh to the fifth, its courſe would be more in the ordinary way, and the chorda tympani would be eſteemed a branch of the ſeven pair going to join the fifth, the ſize of which is increaſed by this acquiſition. This ſmaller bundle of the ſeventh gives branches to the muſcles of the malleus, and to the dura mater, while it paſſes through the bony crooked canal, and at laſt comes out in a firm chord named portio dura, at the end of this canal, between the ſtyloid and maſtoid proceſſes of the temporal bone, giving immediately filaments to the little oblique muſcles of the head, and to thoſe that riſe from the ſtyloid proceſs. It then pierces through the parotid gland, and divides into a great many branches, which are diſperſed in the muſcles and teguments that cover all the ſide of the upper part of the neck, the whole face and cranium, as far back as the temples, including a conſiderable part of the external ear. Its branches having thus a conſiderable connection with all the three branches of the fifth pair, and with the ſecond cervical, occaſion a great ſympathy of theſe nerves with it. Hence, in the tooth-ach, the pain is ſometimes very little in the affected tooth, compared to what it is all along the ſide of the head and in the ear. Hence probably the relief of the tooth-ach from bliſters applied behind or before the ear, or by a hot iron touching the antihelix of the ear. By this communication or connection poſſibly too it is, that a vibrating ſtring held between one's teeth, gives a ſtrong idea of ſound to the perſon who holds it, which cannot be perceived by any body elſe. Perhaps too the diſtribution of this nerve occaſions the head to be ſo quickly turned upon the impreſſion of ſound on our ears.

The eighth pair of nerves riſe from the lateral baſes of the corpora olivaria in diſgregated fibres; and as they are entering the anterior internal part of the holes common to the os occipitis and temporum, each is joined by a nerve which aſcends within the dura mater from the tenth of the head, the firſt, ſecond and inferior cervical nerves: this every body knows has the name of the nervus acceſſorius. When the two get out of the ſcull the acceſſorius ſeparates from the eighth, and, deſcending obliquely outwards, paſſes through the ſterno-maſtoideus muſcle, to which it gives branches, and afterwards terminates in the trapezius and rhomboid muſcles of the ſcapula. In this courſe it is generally more or leſs joined by the ſecond cervical nerve. Why this nerve, and ſeveral others which are diſtributed to muſcles, are made to pierce through muſcles which they might have only paſſed near to, I know not.

The large eighth pair, ſoon after its exit, gives nerves to the tongue, larynx, pharynx, and ganglion of the intercoſtal nerve, and being diſjoined from the ninth and intercoſtal, to which it adheres cloſely ſome way, runs ſtraight down the neck behind the internal jugular vein, and at the external ſide of the carotid artery. As it is about to enter the thorax, a large nerve goes off from the eighth of each ſide: this branch of the right ſide turns round from the fore to the back part of the ſubclavian artery, while the branch of the left-ſide turns round the great curve of the aorta, and both of them mounting up again at the ſide of the œſophagus, to which they give branches, are at length loſt in the larynx. Theſe are called the recurrent nerves, which we are deſired to ſhun in the operation of bronchotomy, though their deep ſituation protects them ſufficiently. The muſcles of the larynx being in a great meaſure ſupplied with nerves from the recurrents, it is to be expected, that the cutting of them will greatly weaken the voice, though it will not be entirely loſt, ſo long as the ſuperior branches of the eighth pair are entire. Why the recurrent nerves riſe ſo low from the eighth pair to go round a large artery, and to have ſuch a long courſe upwards, I know not.

The eighth pair, above and at or near the place where the recurrent nerves go off from it, or frequently the recurrents themſelves, ſend off ſmall nerves to the pericardium, and to join with the branches of the intercoſtal that are diſtributed to the heart; but their ſize and ſituation are uncertain.

After theſe branches are ſent off, the par vagum on each ſide deſcends behind the great branch of the trachea, and gives numerous filaments to the lungs, and ſome to the heart in going to the œſophagus. The one of the left-ſide running on the fore-part of the œſophagus, communicates by ſeveral branches with the right one in its deſcent to be diſtributed to the ſtomach: the right one gets behind the œſophagus, where it ſplits and rejoins ſeveral times before it arrives at the ſtomach, to which it ſends nerves; and then being joined by one or more branches from the left-trunk, they run towards the cæliac artery, there to join into the great ſemilunar ganglion formed by the two intercoſtals.

From the diſtribution of this par vagum, we may find how tickling the fauces with a feather or any ſuch ſubſtance, excites a nauſea and inclination to vomit; why coughing occaſions vomiting, or vomiting raiſes a cough. Hence we ſee how the nervous aſthma and the tuſſis convulſiva, chincough, are attended with a ſtraitening of the glottis; why food difficult to digeſt occaſions the aſthma to weakly people; and why emetics have frequently cured the aſthma very ſpeedily; why an attempt to vomit is ſometimes in danger of ſuffocating aſthmatic people; why the ſuperior orifice of the ſtomach is ſo ſenſible, as to be looked on by ſome as the ſeat of the ſoul; why people ſubject to diſtenſions of the ſtomach, have ſo frequently the ſenſation of balls in their breaſts and throats; why the globus hiſtericus is ſo often attended with a violent ſtrangulation at the glottis.

The ninth pair of nerves comes from the inferior part of the corpora pyramidalia, to go out of the ſcull at their proper holes of the occipital bone. After their egreſs they adhere for ſome way firmly to the eighth and intercoſtal; and then ſending a branch, which in many ſubjects is joined with branches of the firſt and ſecond cervical nerves, to be diſtributed to the thyroid gland and muſcles on the fore-part of the trachea arteria, the ninth is loſt in the muſcles and ſubſtance of the tongue. Some have thought this nerve, and others have imagined the third branch of the fifth pair of nerves, to be the proper guſtatory nerve. I am acquainted with no obſervation or experiments to prove either opinion, or to aſſure us, that both nerves do not ſerve for taſting and for the motion of the tongue. May not the diſtribution of this nerve to the muſcles below, as well as above the os hyoides, contribute to their acting more uniformly in depreſſing the lower jaw or head?

The tenth pair riſes in ſeparate threads from the ſides of the ſpinal marrow, to go out between the os occipitis and firſt vertebra of the neck. After each of them has given branches to the great ganglion of the intercoſtal, 8th, 9th, and 1ſt cervical nerves, it is diſtributed to the ſtraight, oblique, and ſome of the extenſor muſcles of the head. Whether the name of the tenth of the head, or of the firſt vertebral, ſhould be given to this pair of nerves, is of no ſuch conſequence as to deſerve a debate, though it has ſome of the marks of the ſpinal nerves, to wit, its being formed of filaments proceeding from both the fore and back part of the medulla, and a little ganglion being formed where theſe filaments meet.

In deſcribing the ſixth pair, I followed the uſual way of ſpeaking among anatomiſts, and called that the beginning of the intercoſtal nerve which comes out of the ſcull; and therefore ſhall here add a curſory deſcription of this nerve, notwithſtanding its much larger part is compoſed of nerves coming out from the ſpinal marrow. There is no greater incongruity in point of method to ſay, that the nerve we are deſcribing receives additions from others that have not been deſcribed, than it is to repeat in the deſcription of a great many nerves, that each of them gives branches to form a nerve which we are ignorant of; which is all the difference between deſcribing the intercoſtal before or after the ſpinal nerves.

The branch which is reflected from the ſixth pair, joined poſſibly by ſome filaments of the opththalmic branch of the fifth, runs along with the internal carotid artery, through the crooked canal formed for it in the temporal bone, where the little nerve is very ſoft and pappy, and in ſeveral ſubjects divides and unites again, and is joined by one or more branches from the fifth, particularly of its ſuperior maxillary branch, before it comes out of the ſcull. May the compreſſion of this nerve by the carotid artery when ſtretched during the ſyſtole, contribute to the diaſtole of the heart? As ſoon as the nerve eſcapes out of this bony canal, it is connected a little way with the eighth and ninth; then ſeparating from theſe, after ſeeming to receive additional nerves from them, it forms a large ganglion, into which branches from the tenth of the head, and from the firſt and ſecond cervical, enter. From this ganglion the nerves come out again ſmall to run down the neck along with the carotid artery, communicating by branches with the cervical nerves, and giving nerves to the muſcles that bend the head and neck. As the intercoſtal is about to enter the thorax, it forms another ganglion, from which nerves are ſent to the trachea and to the heart; theſe deſigned for the heart joining with the branches of the eighth, and moſt of them paſſing between the two great arteries and the auricles, to the ſubſtance of that muſcle. The intercoſtal after this conſiſting of two branches, one going behind, and the other running over the fore-part of the ſubclavian artery, forms a new ganglion where the two branches unite below that artery, and then deſcending along the ſides of the vertebræ of the thorax, receives branches from each of the dorſal nerves; which branches appearing to come out between the ribs, have given the name of intercoſtal to the whole nerve. Where the addition is made to it from the fifth dorſal nerve, a branch goes off obliquely forwards; which being joined by ſuch branches from the ſixth, ſeventh, eighth, and ninth dorſal, an anterior trunk is formed, and paſſes between the fibres of the appendix muſculoſa of the diaphragm, to form, along with the other intercoſtal and the branches of the eighth pair, a large ſemilunar ganglion, ſituated between the cæliac and ſuperior meſenteric arteries; the roots of which are as it were involved in a ſort of nervous net-work of this ganglion, from which a great number of very ſmall nervous threads run out to be extended on the ſurface of all the branches of thoſe two arteries, ſo as to be eaſily ſeen when any of the arteries are ſtretched, but not to be raiſed from them by diſſection; and thus the liver, gall-bladder, duodenum, pancreas, ſpleen, jejunum, ilium, and a large ſhare of the colon, have their nerves ſent from this great ſolar ganglion or plexus. May the periſtaltic motion of the inteſtines depend in ſome meaſure on the paſſage of the intercoſtal nerves through the diaphragm?

Several fibres of this ganglion, running down upon the aorta, meet with other nerves ſent from the poſterior trunk of the intercoſtal, which continues its courſe along the ſides of the vertebræ, they ſupply the glandulæ renales, kidneys, and teſtes in men, or ovaria in women; and then they form a net-work upon the inferior meſenteric artery where the nerves of the two ſides meet, and accompany the branches of this artery to the part of the colon that lies in the left ſide of the belly, and to the rectum, as far down as to the lower part of the pelvis.

The intercoſtal continuing down by the ſide of the vertebræ of the loins, is joined by nerves coming from between theſe vertebræ, and ſends nerves to the organs of generation and others in the pelvis, being even joined with thoſe that are ſent to the inferior extremities.

The general connection and communication which this nerve has with the other nerves of the body, may lead us to underſtand the following, and many more phænomena: why tickling the noſe cauſes ſneezing. Why the too great quantity of bile in the cholera occaſions vomiting as well as purging. Why people vomit in colics, in inflammations, or other irritations of the liver, or of the ducts going from it and the gall bladder. Why a ſtone in the kidneys, or ureters, or any other cauſe irritating thoſe organs, ſhould ſo much more frequently bring on vomiting and other diſorders of the ſtomach, than the ſtone does, or any other ſtimulating cauſe in the bladder. Why vomiting is a ſymptom of danger after child birth, lithotomy, and other operations on the parts in the pelvis. Why the obſtructions of the menſes are capable of occaſioning ſtrangulations, belching, colics, ſtomach-aches, and even convulſions in the extremities. Why veſicatories, applied from the ears to the clavicles of children labouring under the tuſſis convulſiva, are frequently of great ſervice. Why worms in the ſtomach or guts excite an itching in the noſe, or grinding of the teeth. Why irritations in the bowels or the belly occaſion ſometimes univerſal convulſions of the body.

The ſpinal nerves generally riſe by a number of diſgregated fibres from both the fore and back part of the medulla ſpinalis, and ſoon after form a little knot or ganglion, where they acquire ſtrong coats, and are extended into firm cords. They are diſtinguiſhed by numbers, according to the vertebræ from between which they come out; the ſuperior of the two bones forming the hole through which they paſs, being the one from which the number is applied to each nerve. There are generally ſaid to be thirty pair of them: ſeven of which come out between the vertebræ of the neck, twelve between thoſe of the back, five between thoſe of the loins, and ſix from the falſe vertebræ.

The firſt cervical pair of nerves comes out between the firſt and ſecond vertebræ of the neck; and having given branches to join with the tenth pair of the head, the ſecond cervical and intercoſtal, and to ſerve the muſcles that bend the neck, it ſends its largeſt branches backwards to the extenſor muſcles of the head and neck; ſome of which piercing through theſe muſcles, run up on the occiput to be loſt in the teguments here; and many fibres of it advance ſo far forward as to be connected with the fibrils of the firſt branch of the fifth pair of the head, and of the portio dura of the auditory nerve. Hence perhaps it is that a clavus hiſtericus changes ſuddenly ſometimes from the fore-head to a violent pain and ſpaſm in the back-part of the head and neck.

The ſecond cervical is ſoon joined by ſome branches to the ninth of the head and intercoſtal, and to the firſt and third of the neck; then has a large branch that comes out at the exterior edge of the ſterno-maſtoideus muſcle, where it joins with the acceſſorius of the eighth pair; and is afterwards diſtributed to the platiſma myoides, teguments of the ſide of the neck and head, parotid gland, and external ear, being connected to the portio dura of the auditory nerve, and to the firſt cervical. The remainder of this ſecond cervical is ſpent on the levator ſcapulæ and the extenſors of the neck and head. A large branch is here generally ſent off to join the acceſſorius of the eighth pair, near the ſuperior angle of the ſcapula.

To the irritation of the branches of this nerve it probably is, that, in an inflammation of the parotid gland, the neck is pained ſo far down as the clavicle, the head is drawn towards the ſhoulder of the affected ſide, and the chin is turned to the other ſide. In opening the external jugular vein, no operator can promiſe not to touch ſome of the cutaneous branches of this nerve with the lancet; which occaſions a ſharp pricking pain in the mean time, and a numbneſs of the ſkin near the orifice for ſome time after.

The third pair of the neck paſſes out between the third and fourth cervical vertebræ; having immediately a communication with the ſecond, and ſending down a branch, which being joined by a branch from the fourth cervical, forms the phrenic nerve. This deſcending enters the thorax between the ſubclavian vein and artery; and then being received into a groove formed for it in the pericardium, it has its courſe along this capſula of the heart, till it is loſt in the middle part of the diaphragm. The right phrenic has a ſtraight courſe; but the left one is obliged to make a conſiderable turn outwards to go over the prominent part of the pericardium, where the point of the heart is lodged. Hence in violent palpitations of the heart, a pungent acute pain is felt near the left orifice of the ſtomach. The middle of the diaphragm ſcarce could have been ſupplied by any other nerve which could have had ſuch a ſtraight courſe as the phrenic has. Whether the ſubclavian artery and vein have any effect upon this nerve I know not.

The other branches of the third cervical nerve are diſtributed to the muſcles and teguments at the lower part of the neck and top of the ſhoulder. It is not ſurprizing then that an inflammation of the liver or ſpleen, an abſceſs in the lungs adhering to the diaphragm, or any other cauſe capable of irritating the diaphragm, ſhould be attended with a ſharp pain on the top of the ſhoulder, as well as wounds, ulcers, &c. of this muſcle itſelf. If the irritation of this muſcle is very violent, it may occaſion that convulſive contraction of the diaphragm which is called an hiccough; and therefore an hiccough in an inflammation of the liver has been juſtly declared to be an ill ſymptom.

An irritation of the thoracic nerves which produces ſneezing, may ſometimes free the phrenic nerves from any ſpaſm they occaſion; ſo that ſneezing ſometimes takes away the hiccough; and a derivation of the fluid of the nerves any other way may do the ſame thing: or the hiccough may alſo be ſometimes cured, by drawing up into the noſe the ſmoak of burning paper or other acrid fumes, ſwallowing pungent or aromatic medicines, and by a ſurprize, or any other ſtrong application of the mind in thinking, or in diſtinguiſhing objects: or, when all theſe have failed, it has been put away by the briſk ſtimulus of a bliſtering plaiſter applied to the back.

The fourth cervical nerve, after ſending off that branch which joins with the third to form the phrenic, and beſtowing twigs on the muſcles and glands of the neck, runs to the arm-pit, where it meets with the fifth, ſixth, and ſeventh cervicals, and firſt dorſal, that eſcape in the interſtices of the muſculi ſcaleni, to come at the arm-pit, where they join, ſeparate, and rejoin, in a manner hardly to be rightly expreſſed in words; and, after giving ſeveral conſiderable nerves to the muſcles and teguments which cover the thorax, they divide into ſeveral branches, to be diſtributed to all the parts of the ſuperior extremity. Seven of theſe branches I ſhall deſcribe under particular names.

1. Scapularis runs ſtreight to the cavitas ſemilunata of the upper coſta of the ſcapula, which is a hole in the recent ſubject by a ligament being extended from one angle of the bone to the other, giving nerves in its way to the muſcles of the ſcapula. When it has paſſed this hole, it ſupplies the ſupra ſpinatus muſcle; and then deſcending at the anterior root of the ſpine of the ſcapula, it is loſt in the other muſcles that lie on the dorſum of that bone.

2. Articularis ſinks downwards at the axilla, to get below the neck of the head of the os humeri, and to mount again at the back-part of

it; ſo that it almoſt ſurrounds the articulation, and is diſtributed to the muſcles that draw the arm back, and to thoſe that raiſe it up.

3. Cutaneus runs down the fore part of the arm near the ſkin, to which it gives off branches; and then divides on the inſide of the fore-arm into ſeveral nerves, which ſupply the teguments there, and on the palm of the hand. In opening the baſilic vein of the arm, at the uſual place, the ſame ſymptoms are ſometimes produced as in opening the external jugular vein, and from a like cauſe, to wit, from hurting a branch of this cutaneous nerve with the lancet.

4. Muſculo-cutaneus, or perforans caſſeri, paſſes through the coracobrachialis muſcle; and, after ſupplying the biceps flexor cubiti and brachiœus internus, paſſes behind the tendon of the biceps, and over the cephalic vein, to be beſtowed on the teguments on the outſide of the fore-arm and back of the hand. This nerve is ſometimes hurt in opening the cephalic vein, and for a ſhort time cauſes pain and numbneſs.

5. Muſcularis has a ſpiral courſe from the axilla, under the os humery, and backward to the external part of that bone, ſupplying by the way the extenſor muſcles of the fore-arm, to which it runs between the two brachiœi muſcles, and within the ſupinator radii longus. At the upper-part of the fore-arm, it ſends off a branch, which accompanies the ſupinator longus till it comes near the wriſt, where it paſſes obliquely over the radius, to be loſt in the back of the hand and fingers. The principal part of this nerve pierces through the ſupinator radii brevis, to ſerve the muſcles that extend the hand and fingers, whoſe actions are not injured when the ſupinator acts.

6. Ulnaris is extended along the inſide of the arm, to give nerves to the muſcles that extend the fore-arm and to the teguments of the elbow: towards the lower part of the arm, it ſlants a little backward to come at the groove behind the internal condyle of the os humeri, through which it runs to the ulna: in its courſe along this bone, it ſerves the neighbouring muſcles and teguments; and as it comes near the wriſt, it detaches a branch obliquely over the ulna to the back of the hand, to be loſt in the convex part of ſeveral fingers. The larger part of the nerve goes ſtraight forward to the internal ſide of the os piſiforme of the wriſt; where it ſends off a branch which ſinks under the large tendons in the palm, to go croſs to the other ſide of the wriſt, ſerving the muſculi lumbricales and interoſſei, and at laſt terminating in the ſhort muſcles of the thumb and fore-finger. What remains of the ulnar nerve after ſupplying the ſhort muſcles of the little-finger, divides into three branches; two whereof are extended along the ſides of the ſheath of the tendons of the flexors of the little finger, to furniſh the concave ſide of that finger; and the third branch is diſpoſed in the ſame way upon the ſide of the ring finger next to the little-finger.

When we lean or preſs on the internal condyle of the os humeri, the numbneſs and pricking we frequently feel, point out the courſe of this nerve. I have ſeen a weakneſs and atrophy in the parts which I mentioned this nerve to be ſent to, after a wound in the internal lower part of the arm.

7. Radialis accompanies the humeral artery to the bending of the elbow, ſerving the flexors of the cubit in its way; then paſſing through the pronator radii teres muſcle, it gives nerves to the muſcles on the fore-part of the fore-arm, and continues its courſe near to the radius, beſtowing branches on the circumjacent muſcles. Near the wriſt, it ſometimes gives off a nerve which is diſtributed to the back of the hand, and the convex part of the thumb and ſeveral of the fingers, inſtead of the branch of the muſcular. The larger part of this nerve, paſſing behind the annular ligament of the wriſt, gives nerves to the ſhort muſcles of the thumb; and afterwards ſends a branch along each ſide of the ſheath of the tendons of the flexors of the thumb, fore-finger, mid-finger, and one branch to the ſide of the ring-finger, next to the middle one, to be loſt on the concave ſide of thoſe fingers.

Though the radial nerve paſſes through the pronator muſcle, and the muſcular nerve ſeems to be ſtill more unfavorably placed within the ſupinator brevis; yet the action of theſe muſcles ſeems to have no effect in hindering the influence of theſe nerves, for the fingers or hand can be bent while pronation is performing vigorouſly, and they can be extended while ſupination is exerciſed.

The manner of the going off of theſe nerves of the fingers, both from the ulnar and radical, is, that a ſingle branch is ſent from the trunk to the ſide of the thumb and little finger fartheſt from the other fingers; and all the reſt are ſupplied by a trunk of a nerve, which ſplits into two ſome diſtance before it comes as far as the end of the metacarpus, to run along the ſides of different fingers that are neareſt to each other.

It will probably be obſerved, that, in deſcribing the poſterior branches of the ulnar and muſcular nerve, I did not mention the particular fingers, to the convex part of which they are diſtributed. My reaſon for this omiſſion is, the uncertainty of their diſtribution; for though ſometimes theſe poſterior branches go to the ſame fingers, to the concave part of which the anterior branches of the ulnar and radial are ſent, yet they are often diſtributed otherwiſe.

The ſituation of theſe brachial nerves in the axilla, may ſhew us how a weakneſs and atrophy may be brought on the arms by long continued preſſure of crutches, or ſuch other hard ſubſtances on this part; and the courſe of them from the neck to the arm may teach us, how much better effects veſicatories, or ſtimulating nervous medicines, would have, when applied to the ſkin, covering the tranſverſe proceſſes of the vertebræ of the neck, or at the axilla, than when they are put between the ſhoulders, or upon the ſpinal proceſſes, in convulſions or palſies of the ſuperior extremities, where a ſtimulus is required.

The twelve dorſal nerves of each ſide, as ſoon as they eſcape from between the vertebræ, ſend a branch forward to join the intercoſtal; by which a communication is made among them all; and they ſoon likewiſe give branches backwards to the muſcles that raiſe the trunk of the body, their principal trunk being extended outwards to come at the furrow in the lower edge of each rib, in which they run towards the anterior part of the thorax, between the internal and external intercoſtal muſcles, giving off branches in their courſe to the muſcles and teguments of the thorax.

The firſt dorſal, as I have already obſerved, is particular in this, that it contributes to form the brachial nerves; and that the two branches of the intercoſtal, which come down to the thorax, form a conſiderable ganglion with it.

The ſix lower dorſal nerves give branches to the diaphragm and abdominal muſcles.

The twelfth joins with the firſt lumbar, and beſtows nerves on the muſculus quadratus lumborum and iliacus internus.

The communications of theſe lower ones with the intercoſtals, may ſerve to explain the violent effort of the abdominal muſcles in a teneſmus and in child-bearing.

The intercoſtal being larger in the thorax than any where elſe, and ſeeming to diminiſh gradually as it aſcends and deſcends, there is reaſon to ſuſpect that this is the trunk from which the ſuperior and inferior pairs are ſent as branches.

The five lumbar nerves on each ſide, communicate with the intercoſtal and with each other, and give branches backwards to the loins.

The firſt communicates with the laſt dorſal, ſends branches to the abdominal muſcles, to the pſoas and iliacus, and to the teguments and muſcles on the fore-part of the thigh; while its principal branch joins with the other nerves, to form the crural nerve.

The ſecond lumbar nerve paſſes through the pſoas muſcle, and is diſtributed nearly in the ſame way as the former; as is alſo the third.

Branches of the ſecond, third, and fourth, make up one trunk, which runs along the fore-part of the pelvis; and paſſing in the notch at the fore-part of the great hole common to the os pubis and iſchium, is ſpent on the abductor muſcles, and on the teguments on the inſide of the thigh. This nerve is called the obturator, or poſterior crural nerve.

By united branches from the firſt, ſecond, third, and fourth lumbar nerves, a nerve is formed that runs along the pſoas muſcle, to eſcape with the external iliac veſſels out of the abdomen, below the tendinous arcade of the external oblique muſcle. This nerve, which is named the anterior crural, is diſtributed principally to the muſcles and teguments on the fore-part of the thigh. A branch, however, of this nerve, runs down the inſide of the leg to the upper part of the foot, keeping near to the vena ſaphæna; in opening of which with a lancet at the ankle, the nerve is ſometimes hurt, and occaſions ſharp pain at the time of the operation, and numbneſs afterwards.

The remainder of the fourth lumbar and the fifth, join in compoſing the largeſt nerve of the body.

Whoever attends to the courſe of theſe lumbar nerves, and of the ſpermatic veſſels and nerves upon the pſoas muſcle, with the oblique paſſage of the ureter over that muſcle, will not be ſurpriſed, that when a ſtone is paſſing in this canal, or even when it is inflamed, the trunk of the body cannot be raiſed erect without conſiderable pain; or that the ſkin of the thigh becomes leſs ſenſible, and the thigh is drawn forward; and that the teſticle often ſwells, and is drawn convulſively towards the ring of the abdominal muſcles.

The ſixth pair of the falſe vertebræ conſiſt each of ſmall poſterior branches ſent to the hips, and of large anterior branches.

The firſt, ſecond, and third, after coming through the three upper holes in the fore-part of the os ſacrum, join together with the fourth and fifth of the loins, to form the largeſt nerve of the body, which is well known by the name of ſciatic or iſchiatic nerve: this, after ſending large nerves to the different parts of the pelvis, to the external parts of generation and the podex, and to the muſcles of the hips, paſſes behind the great tuber of the os iſchium, and then over the quadrigemini muſcles to run down near to the bone of the thigh at its back part, giving off nerves to the neighbouring muſcles and teguments. Some diſtance above the ham, where it has the name of the poplitæus nerve, it ſends off a large branch that paſſes over the fibula, and ſinking in among the muſcles on the anterior external part of the leg, runs down to the foot, to be loſt in the upper part of the larger toes, ſupplying the neighbouring muſcles and teguments every where in its paſſage.

The larger branch of the ſciatic, after giving branches to the muſcles and teguments about the ham and knee, and ſending a large cutaneous nerve down the calf of the leg, to be loſt at laſt on the outſide of the foot and upper part of the leſſer toes, ſinks below the gemellus muſcle, and diſtributes nerves to the muſcles on the back of the leg; among which it continues its courſe, till paſſing behind the internal malleolus, and in the internal hollow of the os calcis, it divides into the two plantar nerves; the internal of which is diſtributed to the toes, in the ſame manner that the radial nerve of the hand ſerves the concave ſide of the thumb and fingers; and the external plantar is divided and diſtributed to the ſole of the foot and toes, nearly as the ulnar nerve is in the palm of the hand, and in the concave part of the fingers.

Several branches of theſe nerves that ſerve the inferior extremities, pierce through muſcles.

By applying what was ſaid of the nerves in general to the particular diſtribution of the nerves of the inferior extremities, we may ſee how people with fractured legs, eſpecially where there are ſplinters, ſhould be ſubject to convulſive ſtartings of the fractured member. Why, upon tying the blood-veſſels in an amputation of the leg, the patients ſhould ſometimes complain of violent pain in their toes;---why ſuch patients ſhould alſo be troubled with ſtartings;---why, for a conſiderable time after the amputation of the diſeaſed limb, when the ſuppuration is well advanced, they ſhould complain of pain in the ſore which occaſioned the amputation.

The fourth, which, with the two following, is much ſmaller than the three ſuperior, ſoon is loſt in the veſica urinaria and inteſtinum rectum.

The fifth comes forward between the extremity of the os ſacrum and coccygis, to be diſtributed principally to the levatores ani.

The ſixth, which ſome think to be only a production of the dura mater, advances forward below the broad ſhoulders of the firſt bone of the os coccygis, and is loſt in the ſphincter ani and teguments covering it.

The branches of the four laſt cervical nerves, and of the firſt dorſal, which are beſtowed on the ſuperior extremities, and the two crurals, with the ſciatic, which are diſtributed to the inferior extremities, are much larger proportionally to the parts they ſerve, than the nerves of the trunk of the body, and eſpecially of the viſcera, are; and for a very good reaſon, that in the moſt common neceſſary actions of life, a ſufficient quantity of fluid, on which the influence of nerves ſeems to depend, may be ſupplied to the muſcles there, which are obliged to perform more frequent and violent contractions than any other parts do.

The nerves of the inferior extremities ſeem larger proportionally than in the ſuperior extremities; the inferior extremities having the weight of the whole body to ſuſtain, and that frequently at a great diſadvantage. What the effect is of the nerves here being injured, we ſee daily; when people happen, by ſitting wrong, to compreſs the ſciatic nerve, they are incapable for ſome time after to ſupport themſelves on the affected extremity: and this is ſtill more remarkable in the ſciatic or hip-gout, in which the member is not only weakened, but gradually ſhrivels and waſtes.

The Deſcription of the human lacteal Sac and Duct.

The receptaculum chyli of Pecquet, or ſaccus lacteus of Van Horne, is a membranous ſomewhat pyriform bag, two thirds of an inch long, one third of an inch over in its largeſt part when collapſed; ſituated on the firſt vertebra of the loins to the right of the aorta, a little higher than the right emulgent artery, behind the right inferior muſcle of the diaphragm: it is formed by the union of three tubes; one from under the aorta, the ſecond from the interſtice of the aorta and cava, the third from under the emulgents of the right ſide. The lacteal ſac, becoming gradually ſmaller towards its upper part, is contracted into a ſlender membranous pipe, of about a line diameter, which is generally named the thoracic duct. This paſſes betwixt the muſcular appendices, or inferior muſcles of the diaphragm, on the right of, and ſomewhat behind the aorta; then, being lodged in the cellular ſubſtance behind the pleura, it mounts between the aorta and the vena azygos as far as the fifth vertebra of the thorax, where it is hid by the azygos, as this vein riſes forwards to join the deſcending or ſuperior cava; after which the duct paſſes obliquely over to the left ſide behind the œſophagus, aorta deſcendens, and the great curvature of the aorta, until it reaches the left carotid artery; behind which, on the left ſide of the œſophagus, it runs to the interſtice of the firſt and ſecond vertebra of the thorax, where it begins to ſeparate from the carotid, ſtretching farther towards the left internal jugular vein by a circular turn, whoſe convex part is uppermoſt. At the top of this arch it ſplits into two for a line and an half; the ſuperior branch receiving into it a large lymphatic veſſel from the cervical glands. This lymphatic appears, by blowing air and injecting liquors into it, to have few valves. When the two branches are again united, the duct continues its courſe towards the internal jugular vein, behind which it deſcends, and, immediately at the left ſide of the inſertion of this vein, enters the ſuperior poſterior part of the left ſubclavian vein, whoſe internal membrane duplicated, forms a ſemilunar valve that is convex externally, and covers two thirds of the orifice of the duct; immediately below this orifice, a cervical vein from the muſculi ſcaleni enters the ſubclavian.

The coats of the ſac and duct are thin tranſparent membranes; from the inſide of which, in the duct, ſmall ſemilunar valves are produced, moſt commonly in pairs; which are ſo ſituated, as to allow the paſſage of liquors upwards, but oppoſe their return in an oppoſite courſe. The number of theſe is generally ten or twelve.

This is the moſt ſimple and common courſe, ſituation, and ſtructure of the receptaculum chyli and thoracic duct; but having had occaſion to obſerve a variety in theſe parts, of different ſubjects, I ſhall ſet down the moſt remarkable of them.

The ſac is ſometimes ſituated lower down than in the former deſcription; is not always of the ſame dimenſions; is not compoſed of the ſame number of ducts; and frequently appears to conſiſt of ſeveral ſmall cells or ducts, inſtead of being one ſimple cavity.

The diameter of the duct is various in moſt bodies, and is ſeldom uniform in the ſame ſubject; but frequently ſudden enlargements or ſacculi of it are obſervable. The diviſions which authors mention of this duct are very uncertain. I have ſeen it divided into two, whereof one branch climbed over the fore-part of the aorta at the eighth vertebra of the thorax, and at the fifth ſlipped behind that artery, to join the other branch which continued in the ordinary courſe. The preciſe vertebra, where it begins to turn to the left ſide, is alſo uncertain. Frequently it does not ſplit at its ſuperior arch; in which caſe a large ſac is found near its aperture into the ſubclavian vein. Generally it has but one orifice; though I have ſeen two in one body, and three in another: nay, ſometimes it divides into two, under the curvature of the great artery; one goes to the right, another to the left ſubclavian vein; and I have found this duct diſcharging itſelf entirely into the right ſubclavian. The lymphatic veſſel which enters its ſuperior arch, is often ſent from the thyroid gland.

The End of the LECTURES *on* ANATOMY.